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April 30, 1988

Energy Research Abstracts

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ENERGY RESEARCH ABSTRACTS

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The Department of Energy's Scientific and Technical Information Program (STIP) is carried out at many levels within the Department and by its contractor organizations. The Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, provides direction and leadership for STIP and serves as DOE's national center for scientific and technical information management and dissemination. Both DOE-originated information and worldwide literature regarding advances in subjects of interest to DOE researchers are collected, processed, and disseminated through an energy information system maintained by OSTI. The major data bases in this system are available within the United States through commercial on-line systems and to those outside the United States through formal governmental exchange agreements. The current-year records for the major data bases, plus a number of specialized data bases are available to DOE offices and contractors through OSTI's Integrated Technical Information System (ITIS). ITIS also serves as a gateway to other government and commercial systems and provides information merging for customized information products. To manage DOE's information resources effectively, DOE's Scientific and Technical Information Program is one of continual development and evaluation of new information products, systems, and technologies.

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. **The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

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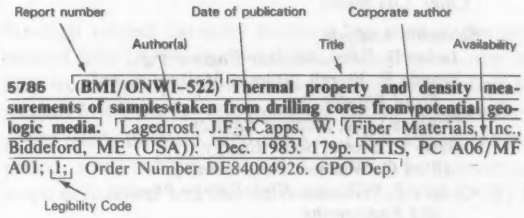
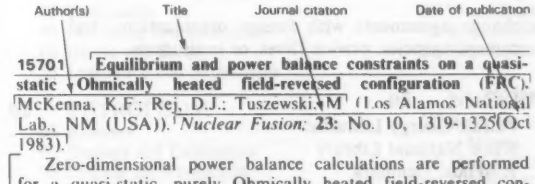
The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.



5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS, PC A06/MF A01; 1; Order Number DE84004926. GPO Dep.

Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.



15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). *Nuclear Fusion*; **23**: No. 10, 1319-1325 (Oct 1983).

Abstract

Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS Order Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
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Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
Energy Balance
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830	**Fiber Materials, Inc., Biddeford, ME (USA)**	
	9:5785	BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under an Order Number, that number is included in the availability statement. An Order number–report number correlation is included for convenience.

BMI/ONWI-522	9:5785	NTIS, PC A09/MF A01. Order Number DE84004926, Distribution Category MN-70

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IEA Coal Research
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Communication concerning the editorial policy and content of *Energy Research Abstracts* should be addressed to the Editor, *Energy Research Abstracts,* Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831.

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

17405 **(IEACR—03) Coal Research Centres.** (International Energy Agency Coal Research, London (UK)). Nov 1987. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88900261/JAW.

The Coal Research Centres Directory is a directory of organizations currently carrying out research in the field of coal science and technology. The directory lists 140 centres in 23 countries. Indexes are provided for research centre and research fields. The research fields index lists the research centres under a number of subject headings corresponding to the specific areas of research in which the centres are involved. The subject headings are based on those used in Coal abstracts, and the order is the same as the one used in this publication.

0103 Preparation

REFER ALSO TO CITATION(S) 17461, 17578, 17617, 17620, 17661

17406 **(DOE/EH—0059) Report to the Secretary of Energy concerning factors to be considered in the first Innovative Clean Coal Technologies Program solicitation.** (Innovative Control Technology Advisory Panel, Washington, DC (USA)). Dec 1987. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005873/JAW.

The Innovative Control Technology Advisory Panel (ICTAP) in its first meeting September 30, 1987, received a series of information briefings on project selection criteria that have been used in the Clean Coal Technology Program (CCTP) or have been proposed by the public, by the Congress or by the Special Envoys for Acid Rain. The panel then discussed a series of factors that might be considered in the Department of Energy's development of project selection criteria for the anticipated first projects solicitation of the Innovative Control Technologies Program. After the discussion at the meeting of the panel, a number of panel members provided written suggestions to be incorporated into this report and that were made available to all panel members. This report reflects the panel member proposals in the meeting and those subsequently made in writing. Given factors to be considered: no limitation on project location in US; new, retrofit, and repower demo projects; and minimum 50% non-federal cost-sharing. Other factors: technologies which in their commercial form would have the potential to reduce emissions in the absence of new legislation; extent of project financing obtained; ability of the proposer to design, build, and operate the project; ability and desire of the proposer or his team members to commercialize the technology; firm evidence of access to the site of the demonstration; evidence of the legal entity to carry out the project; readiness of the technology to be demonstrated; and technology replication.

17407 **(DOE/FC/10508—2332) Industrial scale peat use demonstration at Syl Laskin Steam Electric Station: Final report.** (EKONO, Inc., Bellevue, WA (USA); Minnesota Power and Light Co., Duluth (USA); Minnesota Dept. of Natural Resources, St. Paul (USA)). Nov 1986. 146p. NTIS, PC A07. Order Number DE87010180/JAW.

Minnesota Power and the Minnesota Department of Natural Resources conducted the Industrial Scale Peat Use Demonstration in 1985 at the Syl Laskin Steam Electric Station. The Station is located near Hoyt Lakes, Minnesota. The two unit station commissioned in 1951 was designed to fire bituminous coal. Its current capacity is 88 MW (2 units of 44 MW each) fired with western subbituminous coal. The Demonstration focused on two areas: the Syl Laskin Station and the Fens Bog areas northwest of Cotton, Minnesota. Two past producers were contracted to produce and stockpile up to 25,000 tons of sod peat. One trucking company was contracted to transport the peat to the Station, where it was received, mixed with coal in various proportions, and burned between June 1985 and January 1986. The results of this demonstration are provided in this report. 9 figs., 10 tabs.

17408 **(DOE/PC/62695—T5) Characterization and evaluation of washability of Alaskan coals: Fifty selected seams from various coal fields: Final technical report, September 30, 1976-February 28, 1986.** Rao, P.D. (Alaska Univ., Fairbanks (USA). Mineral Industry Research Lab.). Sep 1986. Contract FG22-83PC62695. 198p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE87014189/JAW.

This final report is the result of a study initiated in 1976 to obtain washability data for Alaskan coals, to supplement the efforts of the US Department of Energy in their ongoing studies on washability of US coals. Washability characteristics were determined for fifty coal samples from the Northern Alaska, Chicago Creek, Unalakleet, Nenana, Matanuska, Beluga, Yentna and Herendeen Bay coal fields. The raw coal was crushed to 1-1/2 inches, 3/8 inch, 14 mesh and 65 mesh top sizes, and float-sink separations were made at 1.30, 1.40 and 1.60 specific gravities. A limited number of samples were also crushed to 200 and 325 mesh sizes prior to float-sink testing. Samples crushed to 65 mesh top size were also separated at 1.60 specific gravity and the float and sink products were characterized for proximate and ultimate analyses, ash composition and ash fusibility. 72 refs., 79 figs., 57 tabs.

17409 **(DOE/PC/79799—T4) The demonstration of an advanced cyclone coal combustor, with internal sulfur, nitrogen, and ash control, for the conversion of a 23 MMBtu/hour boiler to coal: Third quarterly progress report, September 1, 1987-December 31, 1987.** (Coal Tech Corp., Merion, PA (USA)). 1987. Contract FC22-87PC79799. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004799/JAW.

As part of the Department of Energy's Clean Coal Progra,m, Coal Tech Corp. is demonstrating the commerical readiness of an advanced cyclone coal combustor for "new" or "retrofit" applications on industrial or utility boilers. This advanced combustor can control SO_2 and NO/sub x/ emissions to near new source performance standards and at the same time retain and reject ash, sorbent, and sulfur compound solids as slag upstream of the boiler. During this period, all the major components required for the modification of the combustor facility to dry coal operation were installed at the Keeler test site. This included the coal storage, delivery and feed system, and the stack particulate scrubber system. In addition, the controls for these sub-systems were installed. The installation work was completed at the beginning of November, somewhat less than one month behind the planned schedule. Figure 1 shows the combustor installed on the Keeler boiler, and figure 2 shows the boiler house and the scrubber and coal storage systems. Two combustor shakedown tests were implemented during Phase II. Additional short duration tests have been implemented in Phase III, for a total to date of 5 one-day tests, consisting of about 50 hours of combustor operation in which eight tons of dry pulverized coal were consumed. The combustor has been tested from coal start to full boiler thermal rating in several of the tests. When added to the coal water slurry tests which were implemented in the spring of 1987 under another project, the total combustor operating time has reached 90 hours, and 18 tons of coal fuel have been consumed.

17410 **(DOE/PC/79799—T5) The demonstration of an advanced cyclone coal combustor, with internal sulfur, nitrogen, and ash control, for the conversion of a 23 MMBtu/hour boiler to coal: Second quarterly progress report, June 1, 1987-August 31, 1987.** (Coal Tech Corp., Merion, PA (USA)). 1987. Contract FC22-87PC79799. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004665/JAW.

As part of the Department of Energy's Clean Coal Program, Coal Tech Corp. is demonstrating the commercial readiness of an advanced cyclone coal combustor for "new" or "retrofit" applications on industrial or utility boilers. This advanced combustor can control SO_2 and NO/sub x/ emissions to near new source performance standards and at the same time retain and reject ash, sorbent, and sulfur compound solids as slag upstream of the boiler. During this period, all the major components required for the modification of the combustor facility to dry coal operation were ordered and delivered to the test site. The primary facility modifications consisted of the addition of a coal storage, delivery and feed system, and a stack particulate scrubber system. Sub-contracts for installing this equipment were awarded to three contractors. The installation work was scheduled for the September and October 1987 time period. Additional accomplishments during this period were: the stack scrubber design was modified for placement on the roof of the boilerhouse, instead of inside the building as in the original design; a limited development effort was implemented to determine the appropriate design of a pneumatic dry pulverized coal and limestone conveying system; and a control system for the scrubber was designed.

17411 **(DOE/PC/90539—T3) Room temperature measurements of volatiles from crushed coal: First annual report.** Sutter, J.R.; Halpern, J.B. (Howard Univ., Washington, DC (USA). Dept. of Chemistry). 10 Dec 1987. Contract FG22-86PC90539. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003809/JAW.

At the end of the first year of this project, construction of the grinding apparatus has been completed and preliminary work has been done to optimize the experimental design. Progress was greatly hampered by late delivery of the grinding apparatus. This equipment was specified in October 1986 and ordered by the University in November 1986 and delivered in the middle of June 1987. Other tasks accomplished in the first year included repair, alignment and calibration of subsidiary apparatus including a TGA system and a bomb calorimeter. 6 figs.

17412 **(EPRI-CS—5422) Cleaning Kentucky No. 9 Seam coal for SO_2 compliance and using fly ash-derived magnetite for coal cleaning, Coal Quality Development Center: Campaign Report No. 7: Interim report.** Suardini, P.J.; Torak, E.R.; Bhowmick, A.K.; Cavalet, J.R. (Kaiser (Raymond) Engineers, Inc., Homer City, PA (USA). Homer City Office; Science Applications International Corp., Homer City, PA (USA). Homer City Office). Dec 1987. 242p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920140/JAW.

This report presents the results from two studies: the first a comprehensive investigation conducted at EPRI's Coal Quality Development Center to determine if physically cleaning Kentucky No. 9 Seam coal is an effective method for meeting SO_2 emission control requirements and reducing power plant capital and operating costs, and the second an investigation into substituting fly-ash-derived magnetite for natural magnetite in commercial heavy-media coal cleaning circuits. Results of the first study show that cleaning reduced the Kentucky No. 9 Seam raw coal's SO_2 emission and ash loading potentials by 36 and 47%, respectively, while retaining 88% of the coal's heating value. Extensive bench- and pilot-scale combustion tests performed under EPRI Project 2425-1 by Combustion Engineering and Babcock & Wilcox on the raw and two CQDC-produced clean coals (one medium-cleaned, the other deep-cleaned) reveal that commercial power plant performance would be improved considerably by burning the clean coals. The Tennessee Valley Authority (TVA) and EPRI, the test sponsors, also concluded through economic analyses that incorporating medium-depth coal cleaning into various SO_2 emission control strategies can greatly reduce power plant and flue-gas desulfurization system capital and operating costs. The second study used laboratory and commercial-scale test results to compare the quality and cleaning performance of three types of magnetite: natural magnetite, magnetite derived from TVA's power plant fly ash, and commercial fly-ash-derived magnetite. A second focus of this study was to determine the extent to which each type of magnetite can be recovered and reused. The results reveal that fly-ash-derived magnetites perform well in commercial heavy-media circuits, but are difficult to recover. 8 refs., 29 figs., 41 tabs.

17413 **(EPRI-CS—5477) Improving the quality of Lower Freeport Seam coal to reduce electricity costs, Coal Quality Development Center: Campaign Report No. 9: Interim report.** Bencho, J.R.; Torak, E.R.; Cavalet, J.R. (Kaiser (Raymond) Engineers, Inc., Homer City, PA (USA). Homer City Office; Science Applications International Corp., Homer City, PA (USA). Homer City Office). Dec 1987. 168p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920138/JAW.

This report presents the results of a characterization of the coal's response to cleaning and an assessment of how modifying the coal's quality affects a new power plant. The Lower Freeport Seam extends over large areas of Pennsylvania, Ohio, and West Virginia - a reserve conservatively estimated to contain over five billion tons. The specific coal characterized is from an underground mine in Indiana County, Pennsylvania. The characterization involved cleaning the coal to two different quality levels: (1) intense cleaning to produce clean coal meeting an SO_2 emission limit of 1.20 lb/MBtu (1971 New Source Performance Standards) and (2) conventional cleaning aimed at reducing SO_2 as much as possible while recovering at least 80% of the raw coal's original energy. Intensive cleaning produced clean coal with an SO_2 emission potential of 1.26 lb/MBtu; approaching but did not meet the SO_2 emission potential target because of difficulty in removing sulfur from the finest size coal (100 mesh x 0). On the other hand, conventional cleaning reduced the SO_2 emission potential to 1.45 lb/MBtu (a 48.5% reduction) while recovering nearly 83% of the energy. Even with a delivered price nearly $10/ton more than the raw coal, the conventionally cleaned coal combined with partial flue gas scrubbing, provides a 0.5% lower 30-year levelized annual power plant capital, operating, and maintenance cost. This report also contains detailed laboratory washability data, identifies the degree of additional ash and sulfur liberation attainable by crushing the coal, and provides data on the response of the fine coal to cleaning by froth flotation. The report serves as an in-depth source of information about the quality and cleanability of Lower Freeport Seam coal from one mine. 18 refs., 20 figs., 15 tabs.

17414 **(LA—11171-OBES) Advances in preparation techniques for processing microtome sections of peat.** Maestas, L.M.; Raymond, R. Jr.; Cohen, A.D.; Mann, D.A. (Los Alamos National Lab., NM (USA)). Dec 1987. Contract W-7405-ENG-36. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004008/JAW.

Microtome thin sections provide valuable information with which to characterize peat samples. New methods of preparing peat microtome sections have been developed that produce uniform, durable samples in less time. Dehydration and impregnation cages are formed with a punch and die, and impregnated samples are mounted on embedding rings and molds. These modified microtoming procedures, used in conjunction with critical-point-drying and polishing techniques, have led to advances in scanning electron microscopic and reflected-light studies of peats. 8 refs., 21 figs.

17415 **An overview of coal preparation trends in the United States.** Deurbrouck, A.W. (Pittsburgh Energy Technology Center, PA (USA). Coal Preparation Division). *Australian Journal of Mining;* 2: No. 16, 59-62(Dec 1987).

Coal is the most abundant fossil energy process in the United States which possesses almost one third of the world's total supply of recoverable coal reserves. The sulphur content of much of this resource is of concern. How the Americans cope with this and other coal preparation problem is discussed in this paper. Among the items discussed are the research directions of the US DOE, heavy-liquid cyconing, electrostatic separation, froth flotation, air-

sparged hydrocyclone, column and microbubble flotation, and selective agglomeration. 8 figs., 1 tab.

17416 **Low-ash, low-rank coal/water fuel.** Maas, D.J.; Potas, T.A.; Malterer, T.J.; Olson, E.S.; Smit, F.J. (Univ. of North Dakota, Energy Research Center, Grand Forks, ND 58202). pp 13-22 of Proceedings of the 4th annual Pittsburgh coal conference. Greensburg, PA; MEMS (1987). (CONF-870942—).

From 4. annual Pittsburgh coal conference; Pittsburgh, PA, USA (28 Sep 1987).

A North Dakota lignite and Wyoming subbituminous coal were studied in detail, and ash levels were reduced to less than 3.0 wt% and 1.0 wt%, respectively. Methods for reducing the ash involved either gravity separation or froth flotation, followed by an acid leaching step. Hydrothermal treatment is then used as the finishing step in order to achieve high energy density, cleaned slurry fuel. Both coals were cleaned in larger scale batch quantities and hydrothermally treated for rheological characterization. Screening of slurry additives was conducted with the clean, hydrothermally treated Velva and the best additive used with the Kemmerer coal. Particle size optimization studies were also conducted with the Kemmerer subbituminous coal. Results from an innovative technique to prepare low-ash products from low-rank coal, called Colloid Coal Cleaning, are also presented.

17417 **Testing of advanced physical coal cleaning processes - Current status.** Feeley, T.J. III; Hervol, J.D. (U.S. Dept. of Energy, Pittsburgh Energy Technology Center, P.O. Box 10940, Pittsburgh, PA 15236). pp 64-76 of Proceedings of the 4th annual Pittsburgh coal conference. Greensburg, PA; MEMS (1987). (CONF-870942—).

From 4. annual Pittsburgh coal conference; Pittsburgh, PA, USA (28 Sep 1987).

The Department of Energy (DOE) and the Electric Power Research Institute (EPRI) entered into a Project Agreement in August 1984 to develop and evaluate advanced physical fine-coal-cleaning technologies that offer the potential for significantly improved ash and sulfur reductions along with improved heating value recovery. This paper defines the objectives that each competitively-selected process had to meet. The paper describes all three processes that have been selected. The first process selected for proof-of-concept testing is a microbubble flotation scheme developed by Bechtel National, Inc. The other two technologies to be tested through 1989 are Bechtel's selective agglomeration process and a heavy-liquid cycloning process developed by Process Technology, Inc. The paper also describes the three coals selected for proof-of-concept testing, and gives preliminary results of the first program.

0104 Processing

REFER ALSO TO CITATION(S) 17413, 17416, 17608, 17609, 17612, 17612, 17615, 17620, 17638, 17639, 17643, 17643, 17645, 17651, 17651, 17654, 17654, 17695, 17883, 17884, 17885, 17897, 18126, 18127, 18128, 18416, 18742, 18801, 18803, 18919, 19084

17418 (DOE/METC—86/6043, pp 75-82) **Investigation of reactions of heteroatoms during coal gasification.** Zabransky, R.F.; Stock, L.M. (Institute of Gas Technology, Chicago, IL). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract AC21-85MC22063.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The principal objective of this research program is to determine the key reaction pathways that lead to the formation of the oxygen-, sulfur, and nitrogen-containing products formed during the gasification of subbituminous and bituminous coals. The program utilizes a new approach for the assessment of the nature of the product-forming reactions occurring during pyrolysis. It involves modifying the coals in a specific way by a designed synthesis. When appropriate, isotopic labels can also be introduced into the structure. This approach enables the relationship between the structure of the coal and the product to be accurately determined. Most important, the reaction chemistry of the selected structural element can be examined in the environment of real coal molecules. The structural elements to be studied are sulfur heterocycles, thiols, basic and non-basic nitrogen compounds, carboxylic acid derivatives, phenols, ethers and other carbonyl derivatives. The coals to be modified and subsequently gasified are Illinois No.6 and a lower rank, oxygen-rich subbituminous coal.

17419 (DOE/METC—86/6043, pp 83-91) **Ash and slag characterization.** Falcone, S. (Univ. of North Dakota, Grand Forks). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—).

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The objective of this ongoing research project at UNDERC is the development of a unified picture of chemical and mineralogical changes occurring during ashing and slagging of low-rank coals and associated changes in certain slag physical properties during gasification. Specific tasks to be addressed include: (1) the mechanisms operating on the inorganic portion of the coal resulting in mineral transformations affecting ash and slag formation, (2) the nature of the volatile inorganic species released from the coal, and (3) the formation of slag and its composition and physical behavior (i.e. viscosity and surface tension) as related to atmosphere and temperature. The stated project objectives directly support and complement the current gasification research as summarized at the Fifth Annual Gasification Project Contractors' Meeting. The specific areas of operational problems to benefit from this research include slag flow maintenance, ash agglomeration, and the nature of the inorganic volatiles generated during heating.

17420 (DOE/METC—86/6043, pp 102-111) **Chemical and physical development of char particles during devolatilization.** Hamblen, D.G.; Serio, M.A.; Best, P.E. (Advanced Fuel Research, Inc., East Hartford, CT). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract AC21-85MC22050.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The objective of the current project is the acquisition of fundamental data and its use to develop improved predictive models for the physical and chemical behavior of coal in a gasifier. This will be accomplished through a combined theoretical and experimental program which will improve, add to, and integrate models which were developed under the previous program, DOE Contract No. DE-AC21-81FE05122. This new project will focus on providing accurate predictions for the thermal optical, physical and reactive properties of char as they develop during devolatilization under conditions typical of gasifier operation.

17421 (DOE/METC—86/6043, pp 112-120) **Attrition and entrainment studies related to fluidized-bed coal gasifiers.** Knowlton, T. (Institute of Gas Technology, Chicago, IL). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract AC21-85MC22061.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The objectives of this program are to determine the relative importance of mechanical, thermal and chemical reaction attrition of coal chars in a fluidized bed and to determine the variation of entrainment rate and transport disengaging height (TDH) of coal char particles as a function of gas density, gas viscosity and gas velocity. In a fluidized bed, interparticle abrasion and collision in the bed or at the grid, thermal shock and chemical reaction lead to the generation of fines which can be carried out of the bed in the exit gas stream. In fluidized-bed gasification processes (and in coal conversion processes in general) the generation of carbon and ash fines is one of the major problems that must be addressed. Excessive fines generation results in increased costs for particle collection systems (e.g., in cyclones) and high fines recycle rates. The high recycle rates can impose a significant heat penalty on a process. Therefore, it is desirable to minimize the generation and the subsequent carryover of the coal char fines. To do so, it is necessary to determine the chief causes of attrition and the primary variables affecting the entrainment of fines.

17422 (DOE/METC—86/6043, pp 144-153) **Conditioning techniques for mild gasification to produce coproducts.** Graff, R.A.; Zhou, P.; Brandes, S.D. (City College of New York, NY). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract AC21-84MC21315.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The objective of this program is to improve the yield and quality of coproduct from mild gasification processes by conditioning of the feed coal in steam. Steam conditioning of coal and its subsequent mild gasification is being studied in bench scale equipment. Conditioned coal is gasified in a semicontinuous reactor and the products collected. The quality of the coproduct is important to evaluating the potential of this approach. Much of the project effort is devoted to the preparation, collection, and analysis of condensate. It will be necessary to establish how operating conditions, both in steam conditioning and in mild gasification affect the liquid quality as well as its yield. Steam conditioned coal will also be analyzed in order to understand how this procedure has altered the coal structure. Such an understanding may lead to improvements in the technique and new ways to use it to advantage.

17423 (DOE/METC—86/6043, pp 192-200) **Investigations of sulfur tolerance of water-gas catalysts.** Campbell, C.T. (Indiana Univ., Bloomington). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract W-7405-ENG-36.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

Our nation's energy future depends upon effective utilization of our coal resources. In many coal gasification schemes, it is desirable to perform the water-gas shift (WGS) reaction. This increases the hydrogen content of the product stream for either direct H_2 production or for increasing the H_2/CO ratio for hydrogenation catalysis downstream. The purpose of this proposed research is to gain basic understanding of the relationship between surface structure and catalytic activity for the WGS reaction. These studies will determine (1) how Cu/ZnO catalysts poison upon sulfur addition, (2) if the surface of these catalysts can be modified to increase their sulfur tolerance, (3) why MoS_2-based catalysts maintain activity even in the presence of high sulfur levels, and (4) how cobalt and alkali additives function to enhance the activity of these catalysts. The authors philosophy is that by learning how sulfur-intolerant catalysts poison and why other catalysts are sulfur tolerant, they will be in a better position to intelligently design new more active catalysts for water-gas shift which display improved sulfur tolerance.

17424 (DOE/METC—86/6043, pp 211-216) **Separation of gas mixtures by supported complexes.** Lilga, M.A. (Pacific Northwest Lab., Richland, WA). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract AC06-76RL01830.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The goal of this program is to establish the feasibility of coordination complexes as reactive carriers for facilitated transport membrane systems. Emphasis has been placed on systems which can operate using carriers within immobilized liquid membranes or require less than stoichiometric (catalytic) amounts of carriers to accomplish gas separations. The separation of hydrogen from mixtures, such as low-Btu gas, is the specific objective of this research. The selective separation or purification of gases, as for example, hydrogen and carbon monoxide, is highly desirable in several power generation systems based upon product gas from coal gasification units. With such a separation system, gasification with air could be substituted for the generation of synthesis gas in place of oxygen gasification as is now used. Thus, synthesis gas could be generated without the expense of an oxygen plant. Not only would the recovery system reduce capital outlay; it would also improve design flexibility relative to plant scale. Further, the recovery of H_2 and CO from low-Btu gas is expected to benefit production of synthesis gas for fertilizer and methanol manufacture.

17425 (DOE/METC—86/6043, pp 341-350) **Computational fluid dynamics assessment: simulation of METC-advanced gasification concepts entrained reactor.** Celik, I. (West Virginia Univ., Morgantown). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—).

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The objective of this contract is to implement and improve existing computer codes available at METC in simulating fossil-fuel-energy conversion processes. Some of these codes are only marginally validated, and at their current status, they exhibit severe computational difficulties. These codes need to be modified to make them executable and, hence, usable for process simulation. Furthermore, the codes lack proper documentation. In this project, selected codes will be made operational, and applied to specific problems. The changes made in these codes will be documented. The computational results will be analyzed and interpreted for understanding the fluid dynamics phenomena encountered in coal conversion processes. In addition, training and consulting for METC personnel will be provided in implementing these codes.

17426 **(DOE/PC/90756—T1) Research on thermophoretic and inertial aspects of ash particle deposition on heat exchanger surfaces in coal-fired equipment: Quarterly technical report, June 1, 1987-August 31, 1987.** Rosner, D.E. (Yale Univ., New Haven, CT (USA). High Temperature Chemical Reaction Engineering Lab.). Sep 1987. Contract FG22-86PC90756. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004695/JAW.

Our emphasis in the present program is on experimentally validating and developing rational, theoretical methods of predicting the role of inertia and ash particle thermophoresis in determining net deposition rates. We also wish to quantify how simultaneous vapor deposition (e.g., alkali sulfate) can influence the sticking and erosion associated with impacting particles. 6 refs., 2 figs.

17427 **(ORNL/FMP—87/2) AR and TD Fossil Energy Materials Program: Semiannual progress report for the period ending September 30, 1987.** (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 588p. NTIS, PC A25/MF A01; 1; GPO Dep. Order Number DE88006051/JAW.

The objective of the AR and TD Fossil Energy Materials Program is to conduct research and development on materials for fossil energy applications with a focus on the longer-term and generic needs of the various fossil fuel technologies. The program includes research aimed toward a better understanding of materials behavior in fossil energy environments and the development of new materials capable of substantial enhancement of plant operations and reliability. The management of the Program has been decentralized to the DOE Oak Ridge Operations Office (ORO) and the Oak Ridge National Laboratory (ORNL) as technical support contractor. THe ORNL Fossil Energy Materials Program Office compiles and issues this combined semiannual progress report from camera-ready copies submitted by each of the participating subcontractor organizations. It is hoped that this series of AR and TD Fossil Energy Materials Program semiannual progress reports will aid in the dissemination of information developed on the program.

17428 (DOE/METC—87/6079-Vol.1, pp 53-65) **Applications of organo-calcium chemistry to control of contaminant aromatic hydrocarbons in advanced coal gasification processes.** Longwell, J.P.; Peters, W.A. (Massachusetts Institute of Technology, Cambridge). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The overall goal is to provide quantitative understanding of the thermal reactions of aromatic contaminants - with emphasis on freshly formed coal pyrolysis tars and benzene - with calcium oxide under conditions pertinent to in situ, or outboard attenuation of these contaminants from advanced coal gasification process and waste streams. Specific objectives are to: study the cracking of

fresh coal pyrolysis tar over CaO; study benzene cracking over CaO; determine CaO deactivation behavior; and perform a preliminary assessment of process economic implications. Much of the work during the last several months has focused on: (1) preliminary examination of possible economic implications (as inferred from estimated CaO replacement charges) of CaO thermal treatment for high temperature cleanup of streams containing coal tars; and (2) studies aimed at unraveling the contribution of coke and CaO to aromatics conversion over coked calcium oxide. This paper presents details on the economics study. The CaO-coke work involved comparing the activity and selectivity of fresh and coked CaO for conversion of pure aromatic compounds to that of fresh and coked quartz and two carbon forms. 24 references.

17429 (DOE/METC—87/6079-Vol.1, pp 86-99) **Study of the effects of soot, particulate and other contaminants on molten carbonate fuel cells fueled by coal gas.** Klinger, J.; Kennedy, H. (Energy Research Corp., Danbury, CT). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1). Contract AC21-84MC21154.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objective of the 34-month program at Energy Research Corporation (ERC) now being terminated was to study the effects of coal-gas derived contaminants on the performance and endurance of the Molten Carbonate Fuel Cell (MCFC). Additional goals were to evaluate soot deposition due to unstable fuel compositions at typical MCFC temperatures, as well as tar and soot formation due to small amounts of unsaturated and cyclic hydrocarbon contaminants. The goals of this study with respect to contaminant effects were to evaluate, set limits, and suggest clean-up methods for particulates, arsenic, ammonia and trace amounts of volatile metal compounds, including zinc, mercury and Pb-vapor. The present study is one of the first integrated projects to look at the entire spectrum of soot, particulates and contaminant effects both from a short-term fundamental, as well as a longer-term experimental, in-cell, perspective. Results are discussed. 9 references.

17430 (DOE/METC—87/6079-Vol.1, pp 117-122) **Upgrading of condensibles from coal devolatilization.** Mrochek, J.E.; Scott, C.D. (Oak Ridge National Lab., TN). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The primary purpose of this project is to develop alternative or adjunct technologies to hydrotreating for upgrading condensible products derived from low-temperature devolatilization of coal. Hydrotreatment in a packed-bed catalytic reactor will continue to be an important processing tool for coal-derived liquids to minimize concentrations of heteroatom-containing and polynuclear aromatic hydrocarbons which may be hazardous to human health. However, chemical separations to remove these undesirable heteroatom-containing (N, S, and O) contaminants could reduce catalyst poisoning and hydrogen demand in a cost-effective manner. Hydrotreatment could even be eliminated, depending upon the effectiveness and cost of the separations process. Three approaches to separating contaminants from coal-derived condensibles provide potential opportunities for application to the upgrading of coal-derived condensibles. These processes include solvent extraction, solid phase adsorption, and liquid membrane permeation. Primary emphasis during the course of this project will be on solvent extraction and solid phase adsorption technologies. Solvent extraction was selected for initial evaluation because of the existence of a wealth of operating experience in the petrochemical, chemical, and nuclear industries. Based on the existence of extensive knowledge about this process, its extension to the cleanup of coal-derived condensibles should be technically and economically feasible. 11 references.

17431 (DOE/METC—87/6079-Vol.1, pp 137-144) **Reduced entrainment precipitator (REP) for high-temperature and high-pressure (Phase I).** Furlong, D. (ETS, Inc., Roanoke, VA). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

A concept which has potential application for particulate control in advanced combustion systems such as pressurized fluidized beds is the reduced entrainment precipitator (REP). In an electrostatic precipitator, particles once captured, do not necessarily remain captured. Solid particles, especially those with low resistivity properties, are only lightly held to the collecting plate and can be easily dislodged by the gas flowing by the plates. The REP limits this re-entrainment by the use of porous collecting plates, allowing a bleed stream of clean gas to flow through and thus exerting an aerodynamic force on the collected particulate. Five specific tasks were identified for Phase I: demonstrate the REP's capability of collecting high or low resistivity ash; demonstrate that high or low resistivity ash can be collected and held on the plates during the REP precipitation mode and this ash can be dislodged from the plate during the cleaning mode; determine the specific parameters required for application of the REP for HTHP conditions; provide a preliminary design basis for larger scale testing of the REP under HTHP conditions; and develop preliminary economics of the HTHP REP system. Results are briefly discussed. 4 tables.

17432 (DOE/METC—87/6079-Vol.1, pp 150-164) **Hot gas cleanup systems analysis.** Craig, K.R.; Koch, R.W. Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The use of high-temperature, high-pressure cleanup processes hold potential for significantly reducing capital and operating costs and increasing efficiencies in coal-based energy production systems. The goal of the hot gas cleanup systems analysis effort at METC is to determine the interaction of novel cleanup processes on the remainder of these energy systems and identify areas where further research could improve efficiency, reduce costs, or increase a processes chances for development and implementation by the commercial sector. These interactions are determined through engineering analyses conducted using a variety of tools including computerized process models, engineering calculations, and literature studies. The more significant accomplishments achieved during fiscal year 1987 are discussed: assessment of systems and economic issues for in-bed desulfurization in fixed-bed gasifiers; analysis of performance aspects of tail-gas treatment options in gasification island systems; determination of sulfuric acid industry capacity and production; update of estimated zinc ferrite capital and operating costs; assessment of existing zinc ferrite modeling tools; and determination of applicability of hot gas cleanup for methanol production.

17433 (DOE/METC—87/6079-Vol.1, pp 279-288) **Evaluation of a ceramic cross-flow filter in a bench-scale gasifier.** Meyer, J.H.; Westervelt, D.; Anestis, T. (Westinghouse Electric Corp., Pittsburgh, PA). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

This DOE cross flow filter development program being carried out by Westinghouse is intended to obtain information on the operational and economic feasibility of applying the cross flow filter to coal gasification power generating systems. The project has recently been modified in order to allow the test and development of larger and more reliable filter units. This effort includes a longer term test of recently improved small filters, initial testing of a single large element and a large scale test of a multi element - multi module system. This paper provides a brief summary of results and accomplishments from this program's recently active elements: the economic study, the 1000 cycle test, and the first test of a single large filter element. The economic analysis includes estimates of capital and operating costs for the following systems using the cross flow filter: air blown Lurgi fixed bed, the oxygen blown KRW fluid bed gasifier, the oxygen blown Texaco entrained bed gasifier, and an air blown KRW gasifier. Plant size was set at a net 100-MW(e) combined-cycle gasification system with hot gas desulfurization and a heat rate of 9000 Btu/kWh.

17434 (DOE/METC—87/6079-Vol.1, pp 308-320) **Mechanical analysis of a ceramic cross flow filter.** Ciliberti, D.F.; Lippert, T.E.; Kleiner, R.N. (Westinghouse Electric Corp., Pittsburgh, PA). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The primary objective of this program is to develop a more fundamental understanding of the mechanical forces exerted on a cross flow filter when in operation so that means can be devised to avoid mechanical failures of the filter and reliability can be improved. The ceramic cross flow filter has been demonstrated to be a superior high temperature and pressure barrier filter suitable for application in both oxidizing and reducing atmospheres, however, a recurrent operating problem has been experienced in virtually all developmental programs to date. This difficulty manifests itself in a tendency of the layered filter to delaminate along the surface formed by two adjacent layers. This failure is thought to occur during pulse jet cleaning of the filter. It is the major goal of this current program to develop a better understanding of the cause of this type of failure and to develop methods that will reduce or eliminate the problem. The program consists of the following three technical tasks that are to be carried out in a serial fashion: Task 1 is an attempt to improve the mechanical properties of the cross flow filter, Task 2 is concerned with mechanical testing of candidate joining methods and Task 3 is associated with actual HTHP filtration tests to confirm process improvements. Efforts to date have centered on the mechanical analysis of the pressure and thermally induced stresses in the filter during pulse jet cleaning. This analysis is discussed in detail.

17435 (DOE/METC—87/6079-Vol.1, pp 351-362) **Ceramic-fiber ceramic-matrix hot-gas filters.** Stinton, D.P.; Chang, R. (Oak Ridge National Lab., TN). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objective of this program is to develop a ceramic fiber-ceramic matrix composite that will be suitable as a high-temperature particulate filter for use in hot-gas cleanup systems. The goal is to produce a composite that has the requisite strength and toughness, but which also has sufficient porosity to be permeable to the gas stream and the size and distribution of porosity to be an effective filter. A process utilizing chemical vapor deposition was developed for the fabrication of high-temperature particulate filters. Fibrous materials such as Nicalon felt with a pore size of about 100 μm were evaluated as filter mediums. For additional strength Nicalon felt was sandwiched between layers of Nicalon cloth. Preliminary evaluation of the initial Nicalon filters revealed that cleanable filters with collection efficiencies of > 99.9% for either PFBC fly ash or gasifier char could be produced. Simpler filter designs need to be investigated since particulates were often trapped between the cloth layer and felt and delamination of the filters was occasionally observed. Filters consisting of aluminosilicate papers with pore sizes ranging from 1 to 10 μm were successfully prepared but have not been tested. The relationships between filter efficiency, cleanability, strength, toughness, preform design, and deposition conditions need to be established to optimize the properties of the filter materials.

17436 (DOE/METC—87/6079-Vol.2, pp 393-402) **Study of ammonia removal in coal gasification processes using integrated systems approach.** Chang, R.; Unnasch, S. (Acurex Corp., Mountain View, CA). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2). Contract AC21-86MC23275.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The purpose of this project is to investigate process concepts to eliminate ammonia in the gas stream from a coal gasifier at 1000° to 1800°F. It is the objective of this project to review all previous work and to recommend a preferred approach to achieving the goal of reducing the formation of NO/sub x/ from ammonia to environmentally acceptable levels. The recommended concept will be proven by laboratory-scale experimentation using simulate coal gases. The paper discusses ammonia control approaches: catalytic dissociation, catalytic filter, adsorption, nitride formation, NO/sub x/ addition, and catalytic combustion. The two approaches recommended for testing are staged combustion and a combination of staged combustion and catalytic dissociation of ammonia. The test plan and experimental systems are described. 11 references.

17437 (DOE/METC—87/6079-Vol.2, pp 403-412) **Study of ammonia removal in coal gasification processes.** Krishnan, G.N.; Wood, B.J.; McCarty, J.G. (SRI International, Menlo Park, CA). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2). Contract AC21-86MC23087.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objective of this program is to investigate process concepts to eliminate 90% of fuel-bound nitrogen, primarily ammonia, in a temperature range of 540° to 870°C from coal gas streams produced by gasification of bituminous coals. The program is divided into three tasks: (1) Comprehensive review of the literature: identify and assess the effectiveness of concepts for hot gas ammonia removal. Based on a critical review of this information, catalytic decomposition of ammonia was selected as a process concept that has a significant potential for successful development. (2) Development of an experimental test plan: design a protocol to evaluate the performance of several candidate catalysts selected on the basis of the literature review. (3) Catalyst testing: experimentally screen candidates to identify one superior catalyst. Determine the reaction kinetics of this catalyst to provide a quantitative basis for scale-up of the process. Results from all three tasks are discussed. Nickel-based catalysts appear promising. 6 references, 5 figures.

17438 (DOE/METC—87/6079-Vol.2, pp 431-441) **Mechanisms for hot gas cleanup.** Cook, J.M.; Siriwardane, R.V. Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

Calcium-based sorbents are used for sulfur capture in both combustion and gasification applications. A knowledge of the fundamental chemistry of the reactions of sulfur-bearing gases, such as hydrogen sulfide and sulfur dioxide, with calcium-based sorbents is the main goal of this project. X-ray photoelectron spectroscopy (XPS) techniques are being used as the main avenue of approach to determining the experimental data that will be used as the means of obtaining a basic chemical understanding. The experiments are conducted over a temperature range of 25° to 1000°C and are being performed on high purity, single crystal surfaces. Theoretical models which simulate the reactions of sulfur-bearing gases with porous sorbent particles are being used to extrapolate reaction information obtained under high vacuum conditions for comparison with sorbent performance under process conditions. Depth profile studies in conjunction with the XPS experiments on the reacted surfaces will be utilized as the means of determining the depth of penetration of sulfur into the sorbent particle, as well as the penetration depth of the oxygen. The oxidation of the sulfide to the more stable sulfate is important from an environmental viewpoint since the sulfur that remains in the ash that is removed from the bed must be in a stable form for disposal. One project goal is to determine what, if any, environmental problems might result in the disposal of this ash and to determine methods of dealing with them. 18 references.

17439 (DOE/METC—87/6079-Vol.2, pp 451-460) **Removal of H_2S from gasified coal.** Lynn, S. (Lawrence Berkeley Lab., CA). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

When coal is gasified most of the sulfur is converted to H_2S and must be removed before the gas can be used either as a fuel or as synthesis gas. The UCB Sulfur Recovery Process (UCBSRP) is being developed as a general method for removing H_2S from gases. The H_2S is absorbed in a polyglycol ether, then reacted in the liquid phase with SO_2 to form sulfur and water. The process allows high specificity and flexibility; H_2S can be reduced to the part-per-million level or below in the presence of CO_2 and the other compo-

nents of gasified coal. The CO_2 may be left in the original gas stream or it may be co-absorbed and recovered as a separate, sulfur-free product. The process thus has application both to syngas and hydrogen production from O_2-blown gasifiers and to power production using an air-blown gasifier. The development of this process has been divided into a number of tasks: determine the solubilities of H_2S, SO_2, CO_2, CH_4 and other hydrocarbon gases, water and sulfur in the organic solvent as functions of pressure, temperature, and solvent composition; determine the effects of temperature and solvent composition on reaction kinetics; investigate the suitability of steel and other materials of construction for this system; determine the parameters controlling the crystal size distribution of sulfur so that crystals of 100 micrometers or greater will be formed in the process; determine the parameters controlling reactive absorption of hydrogen sulfide by solutions containing sulfur dioxide; set up a computer model of this process to aid in its evolution; and compare the anticipated costs of this process with those of conventional technology. The current status of each task is discussed.

17440 (DOE/METC—87/6079-Vol.2, pp 461-468) **Gas separation by pressure swing adsorption for producing hydrogen from coal.** Yang, R.T. (State Univ. of New York, Buffalo). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2). Contract AC21-85MC22060.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objective of this contract is to develop a zeolite pressure swing adsorption (PSA) process to be used for the production of hydrogen from coal gasification products. For the purpose of understanding and modeling the PSA separation, information must be gathered on the thermodynamic (equilibrium adsorption isotherms) and transport (diffusivities) properties. Therefore, the project encompasses the following four major tasks: measure equilibrium adsorption of pure-component and mixtures of gases on zeolite sorbent; (The gases are H_2, CO, CH_4, CO_2 and H_2S. The sorbent is 5A zeolite. The temperatures are 23 and 100°C and the total pressure range is 0-1000 psia.); measure diffusivities of the above-mentioned gases in 5A zeolite; carry out experiments on PSA cycles using 5A zeolite as the sorbent for separating coal gasification products, to determine the most efficient PSA cycles, and to determine the optimal PSA cycle conditions for the best separations; and develop mathematical models for the PSA cycles which can be used for design, control, and scale-up. Results are given from the first three tasks. 2 figures, 4 tables.

17441 (DOE/METC—87/6079-Vol.2, pp 469-476) **Gas separation using ion exchange membranes for producing hydrogen from synthesis gas.** Noble, R.D. (National Bureau of Standards, Boulder, CO). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The overall goal of the proposed work is to demonstrate the use of facilitated transport membranes in the production of hydrogen from synthesis gas. The objectives of the project are as follows: (1) evaluate the feasibility of candidate facilitated transport liquid membranes for application to the H_2 recovery process; (2) determine the effect of pressure, temperature, feed gas concentration, carrier chemistry, and membrane configuration on the performance of facilitated transport liquid membranes for the separation of CO_2, CO, H_2S, and H_2; (3) determine the lifetime of promising membranes for the separations described above; (4) develop mathematical models for the prediction of experimental results, scale-up, process design, and optimization of a membrane-based separation scheme for producing H_2 from coal; and (5) perform a preliminary process design and economic analysis to demonstrate the feasibility of using membrane technology in coal gasification processes to produce H_2 from coal. Preliminary results are discussed. 3 references, 3 figures.

17442 (DOE/METC—87/6079-Vol.2, pp 477-481) **Separation of gas mixtures by supported complexes.** Lilga, M.A.; Nelson, D.A.; Hallen, R.T. (Pacific Northwest Lab., Richland, WA). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objective of this project is to prepare and investigate coordination complexes that can be used to selectively separate gases from mixtures. Recent research has focused on hydrogen separation. Specific goals are to prepare inexpensive complexes that either react reversibly and specifically with H_2, or reversibly incorporate H_2 into a substrate at rates that are fast enough to be useful in a H_2 separation system. In particular, dimeric complexes of chromium $[(C_5H_4R)Cr(CO)_3]_2$ (R=H, CO_2CH_3, alkyl), are being studied in this project. The basic methodology used is to prepare various derivatives containing substitution on the cyclopentadienyl ligand and screen these derivatives for reversible reaction with H_2. Once reversibility is achieved, kinetic and equilibrium data will be collected to fully characterize the system and possibly elucidate the effects of substituents on H_2 binding. A Rh/Sn complex which reversibly hydrogenates/dehydrogenates cyclohexanone is discussed. While Rh is not inexpensive, it is present in very low concentration and represents a potentially inexpensive yet selective H_2 separation method. 5 references.

17443 (DOE/METC—87/6079-Vol.2, pp 482-494) **Measurement of alkali vapors in PFBC process stream and their removal with a fixed granular-bed sorber.** Lee, S.H.D.; Myles, K.M. (Argonne National Lab., IL). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objectives of this work are to critically measure the alkali-vapor (Na and K) concentration in a pressurized fluidized-bed combustion (PFBC) process stream on a real-time, on-line basis and to demonstrate a fixed granular bed sorber for the control of alkali vapors from the actual PFBC process stream. Three experimental activities have been proceeding during this year: (1) laboratory calibration of the Ames alkali analyzer and the batch-type alkali and particulate sampling train, (2) laboratory study on alkali-vapor capture by stainless steel, and (3) modification of the PFBC/alkali sorber to reduce particulate loading in the PFBC process stream. Results of each activity are discussed. 9 references, 4 figures, 2 tables.

17444 (DOE/METC—87/6079-Vol.2, pp 495-504) **Study of high temperature removal of alkali in a pressurized gasification system.** Bachovchin, D.M.; Alvin, M.A.; Day, L.M. (Westinghouse R & D Center, Pittsburgh, PA). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The overall objective of this work is to develop, to a point of readiness for scale up to pilot plant level, a specific concept for removal of alkali metal vapors from hot gases. This concept, which is applicable to gasification and FBC systems, is to pass the gases through a fixed bed of emathlite, a natural clay, with which the alkali reacts irreversibly. The bed material is replaced annually. Specific goals, corresponding to program tasks, include: identify a commercial process for fabrication of getter pellets and examine processing costs; determine the mechanism, stoichiometry, and kinetics of the gettering reaction in laboratory studies, to provide the data for reactor scale-up; determine the capacity of the emathlite for sodium gettering, particularly in the presence of low concentrations of sodium vapor; and demonstrate the concept by testing fixed beds (~ 10 kg) of getter pellets exposed to alkali-laden combustion gases. Show that the laboratory kinetic data can be used to design fixed bed getter reactors. Results are discussed from all four tasks. 6 references.

17445 (DOE/METC—87/6079-Vol.2, pp 537-541) **Process development unit for coal gasification tied to regenerative hot gas cleanup.** Duthie, R.; Polen, K.; Calderon, A. (Calderon Energy Co., Bowling Green, OH). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The generic problem being addressed by this project is the utilization of coal with any sulfur content in an economical, environmentally acceptable manner. The proposed solution is a new and unique proprietary coal gasification process which is modular in configuration. The purpose of this project is to demonstrate the operation of a commercial scale process module. This includes the engineering, construction and operation to a feed rate of 50 tons per day of high-sulfur (3.2% S) caking coal. The module will operate continuously at pressure (350 psi) and be integrated with its proprietary hot gas cleanup system to yield clean gases free of tars and compounds of sulfur and particulate matter. The complete coal conversion system consists of: a charging mechanism which accepts run-of-mine coal (ROM); a heated vertical pyrolysis tube which removes tars and other volatiles, and agglomerates coal fines; air-blown char gasification with a water-quenching lock hopper for slag removal; separate production of the rich pyrolysis gas and the lean gas from char gasification; hot gas cleanup in which tars are cracked and sulfur and alkali metals are removed in regenerative hot sorbent beds; sorbent regeneration to recover byproduct sulfur; and disposal of inactive sorbent, alkali metals and coal ash as an inert slag. The configuration and operation of the specific components are described.

17446 (DOE/METC—87/6079-Vol.2, pp 567-578) **Sidestream zinc ferrite regeneration testing.** Grindley, T. Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

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It has been known for some years that large potential economic gains can be gained by high-temperature purification of the product of coal gasification for use by gas turbines, fuel cells, etc. An attempt is being made to lay the experimental foundation to bring the technology to fruition. A laboratory-scale unit, essentially consisting of a 2-inch diameter fixed-bed, low-pressure, stainless steel or quartz reactor, has been used to screen and parametrically evaluate numerous sorbents for their ability to desulfurize simulated hot coal gas and to be regenerated. Sorbents identified through lab-scale testing have been evaluated in a sidestream unit consisting of a 6-inch diameter fixed-bed, high-pressure Incoloy 800H reactor. These teats have determined the ability of the sorbents to function in actual hot coal gas from fixed- and fluid-bed gasifiers. Zinc ferrite has been selected for detailed study. This paper summarizes the results from the lab-scale and sidestream units.

17447 (DOE/METC—87/6079-Vol.2, pp 579-590) **METC fixed-bed gasifier.** Pater, K. Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The Morgantown Energy Technology Center (METC) fixed-bed gasification and gas cleanup system is an integrated test facility that is focused on the METC stirred, fixed-bed gasifier with both air- and oxygen-blowing capabilities. The installation includes a novel dry-tar gas cleanup system that sequentially removes contaminants in separate manageable effluent streams. This enhances their further treatment, disposal, or recycling. A major feature of the cleanup system is a first-of-its-kind pressurized Holmes-Stretford desulfurizer plant. The system has been successfully demonstrated on a broad spectrum of US coals from western subbituminous through the highly caking eastern bituminous variety. The system has recently been modified to support development of hot gas cleanup technology. Key issues being addressed are gasifier in-bed sulfur capture, on-line zinc ferrite absorbers to remove H_2S, and recycle of the SO_2 laden absorber regeneration gases to the gasifier for reaction with the ash and discharge in a stable form. This paper describes the studies being done on hot gas cleanup.

17448 (DOE/METC—87/6079-Vol.2, pp 610-613) **Development of a novel nested-fiber filter concept for high-temperature and high-pressure physical cleanup.** Conkle, H.N. (Battelle Columbus Labs., OH). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2). Contract AC21-86MC23251.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The project objective is to develop a gas-filtration system capable of operating at high temperatures and pressure (HTHP) for use in IGCC and PFBC applications. Such systems will require efficient particulate removal at temperatures over 980°C and pressures of 10 to 30 atmospheres. The Nested Fiber Filter (NFF) system is based on the concept of a nest of needle-like fibers made from an alloy suited for the application. Filter action results from particle matter forming dendritic, or chain-like, particulate matter structures on the surface of the fibers. Three tasks are planned to complete the Phase I Assessment effort. The first task, design Alternatives (completed in February, 1987) provided a better mechanistic understanding of fiber filtration, explored how the mechanical functions within the NFF could be achieved, allowed selection of the best candidate system, and produced initial test plans for conducting the cold- and hot-model experiments. The second and current task, Cold Model, involves design, construction and testing of a bench-scale, cold model NFF. Currently an atmospheric pressure module and a high-pressure test unit are under construction with shakedown and testing scheduled to commence in June, 1987. The third task, Hot Model, will serve to verify that the high performance efficiencies achievable at ambient conditions can also be achieved at elevated temperatures and pressures. For this task, a high-temperature bench-scale test module will be constructed and evaluated.

17449 (DOE/METC—87/6079-Vol.2, pp 642-655) **Development of a hot gas cleanup system.** Anderson, G.L.; Berry, F.O. (Institute of Gas Technology, Chicago, IL). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2). Contract AC21-85MC22144.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The overall objective of this program is to develop means to remove reduced sulfur-containing compounds (e.g., H_2S and COS) and HCl from hot coal-derived fuel gases for use in advanced power plants such as integrated coal gasification-combined cycle power plants and coal gasification-molten carbonate fuel cell power plants. The program includes four tasks: (1) laboratory-scale studies to optimize the concentration of cobalt titanate in a sorbent used in the mixed metal oxide process; develop an oxygen regenerable zinc oxide/zinc aluminate sorbent for the mixed metal oxide process; and explore the use of less costly molten carbonate mixtures in the IGT hot HCl removal sorbent, (2) construction of a skid-mounted 3000 SCF/h bench-scale hot gas cleanup process test system, (3) integration of the test system with a 6-inch fluidized-bed gasifier at IGT, and (4) testing of the IGT processes with actual hot coal-derived fuel gases in the new bench-scale unit. This paper discusses optimization of the cobalt titanate sorbent, testing of alternative hot HCl removal sorbents, and construction of the bench-scale hot gas cleanup test unit. 5 references, 8 figures, 3 tables.

17450 (DOE/METC—87/6079-Vol.2, pp 678-692) **Design studies for hot gas cleanup system in a load following mode.** Gal, E.; Cook, C.S.; Furman, A.H. (General Electric Corporate Research and Development, Schenectady, NY). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2). Contract AC21-86MC22247.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objective of this project is to apply hot gas desulfurization technology to a simplified IGCC system operated in a load following mode consisting of a fixed bed, air blown, dry ash coal gasifier, hot fuel gas desulfurization, and a steam-injected aircraft-derivative gas turbine. A conceptual system design has been developed for a commercial-scale 50 MW electric power generation system based on the simplified IGCC concept. An adaptation of the hot gas desulfurization portion of that design is being developed for installation on an existing air-blown fixed bed gasification facility for proof-of-concept testing. The design characteristics to be evaluated in the proof-of-concept system test include: operation at gasifier pressure and temperature (300 psia, 1100°F); achievement of greater than 90% overall sulfur removal efficiency; reduction of particulate concentration to levels acceptable for gas turbine and NSPS requirements; minimization of net consumption of sorbent material; production of an SO_2-rich regeneration tail gas stream that can be

economically treated; demonstration of projected economical operation in a commercial-size system; and generation of a database for a commercial-scale system design. The design includes a complete engineering package for construction of the proof-of-concept system including process flow diagrams, vessel designs, piping and instrumentation diagrams, general arrangement drawings, and equipment specifications. Design studies will address the impact of the cost-of-electricity of this design concept by comparison to previous studies of other coal-to-electricity systems. Results to date are discussed. 19 references, 7 figures.

17451 (DOE/METC—87/6079-Vol.2, pp 693-703) **Enhanced durability and reactivity for zinc ferrite desulfurization sorbent.** Baltich, L.K.; Berggren, M.H.; Harrison, D.P. (AMAX Research & Development Center, Golden, CO). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The prime objective of this project is to identify and investigate methods for enhancing the durability and reactivity of the zinc ferrite desulfurization sorbent. The enhancement is to be judged by comparing the reactivity and durability of the sorbents prepared and tested in the program against two base case samples. The objective will be accomplished by preparing a large number of sorbent samples representing modified chemical compositions and agglomeration and induration procedures. Selected samples that meet the requirements of the physical characteristics will be used in sulfidation/regeneration tests to determine their reactivity. These sorbent samples will be characterized before and after testing to determine their durability. The resulting data will be analyzed to categorize the sorbents and establish the chemical composition and agglomerating and induration procedures that result in the most reactive and durable sorbent. Results from sorbent preparation and bench-scale testing and analysis are given. 4 references, 4 figures, 2 tables.

17452 (DOE/METC—87/6079-Vol.2, pp 716-725) **Dynamic simulation models for high-temperature desulfurization processes.** Wang, J.; Cockrill, D.; Groves, F.R. Jr.; Harrison, D.P. (Louisiana State Univ., Baton Rouge). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2). Contract AC21-86MC23089.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objective of the research is the preparation of dynamic simulation models capable of describing both the sulfidation and regeneration cycles in fixed-, fluidized-, and moving-bed reactors. The models should be capable of matching breakthrough curves, sulfur loadings, and temperature fronts obtained from experimental reactors. The isothermal fixed-bed modeling effort has progressed to the stage of identifying relevant experimental results to permit testing and calibration of the model. For the nonisothermal fixed-bed model and the other reactor configurations, the mathematical analysis has been completed, and appropriate numerical techniques have been identified. Preliminary numerical results will be available in the near future. 6 references.

17453 (DOE/METC—87/6079-Vol.2, pp 726-740) **Detailed studies of novel regenerable sorbents for high-temperature coal-gas desulfurization.** Flytzani-Stephanopoulos, M.; Jothimurugesan, K.; Lew, S.; Gavalas, G.R.; Patrick, V. (Massachusetts Institute of Technology, Cambridge). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The overall objective of this work is to study in detail the effects of preparation, chemical composition and structural properties on the reactivity, stability, and regenerability of novel mixed oxide H_2S sorbents over the temperature range of 1000°-1500°F. The sorbents selected for this study include both CuO- and ZnO-based materials. The specific objectives of the project are to: investigate the effects of additives such as Al_2O_3 and TiO_2 on the reduction stability and overall performance of CuO- and ZnO-based sorbents; carry out comparative fixed-bed studies of sulfidation-regeneration with different compositions of sorbents prepared in granular form, and select most promising sorbent types; conduct parametric studies of regeneration of the selected sorbents and correlate sorbent regenerability and composition of regeneration off-gas to regeneration conditions for each sorbent type; and prepare selected sorbents in extruded form (1/8" dia.) with a good balance of porosity and mechanical strength. Test best sorbents in many (10-15) sulfidation-regeneration cycles in a lab-scale, fixed-bed reactor. Results from the study of Cu-Fe-Al-O and Zn-Ti-O sorbents are discussed. Preparation and testing of three porous sorbent extrusions of good mechanical strength are described. 8 references, 5 figures, 4 tables.

17454 (DOE/METC—87/6079-Vol.2, pp 741-748) **Integration and testing of hot desulfurization and entrained flow gasification for power generation system.** Becker, M.W.; Leininger, T.L.; Robin, A.M. (Texaco Inc., Montebello, CA). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The primary objective of this project is to demonstrate, on a pilot plant scale, an integrated coal gasification combined cycle (IGCC) electric power generation system utilizing hot gas desulfurization and the commercially proven Texaco Coal Gasification Process. Both in-situ and external hot gas desulfurization will be investigated. New specialized instrumentation developed for coal gasification will also be tested during this work. The test plan and current status of the Texaco Gasification process are described.

17455 (DOE/METC—87/6079-Vol.2, pp 749-757) **Bench-scale testing of novel desulfurization sorbents.** Harkins, S.M.; Gangwal, S.K. (Research Triangle Institute, Research Triangle Park, NC). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2). Contract AC21-86MC23126.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objectives of this contract are to perform bench-scale evaluation and preliminary engineering/economic assessment of novel high temperature desulfurization sorbents which have shown promising results at the laboratory scale. The emphasis is on testing sorbent formulations which have shown potential for high-efficiency hydrogen sulfide removal down to 1 ppmv and/or for stable operation at sulfidation temperatures greater than 650°C. Based on the laboratory-scale novel sorbent research, DOE/METC selected four sorbent formulations for further bench-scale evaluation under this contract. These formulations are: (ZnO)/sub 0.86/(CuO)/sub 0.14/ Fe_2O_3; (ZnO)/sub 0.8/ (TiO_2); (3CuO)(Fe_2O_3)(Al_2O_3); and (CuO)(Al_2O_3). Preliminary results are described.

17456 (NP—8770045, pp 64-83) **Brown coal liquefaction and situation of Australia.** Takahashi, Masamichi. (Japan Brown Coal liquefaction Co. Ltd.). 20 Sep 1985. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

In Proceedings of parallel sessions for the 5th NEDO general assembly.

This study was performed as a link forming a chain of research work funded by NEDO. At present on a brown coal in Victoria State in Australia as an objective, a research and development is performed to obtain an optimum technology intended to convert the coal to a liquified fuel capable of being transported in an economical manner. And a pilot plant is under construction with a capacity of 150 t/d at Mowell about 150 km distant from Melbourne. The paper is on the Australian situation surrounding the project starting from the labor union problems. On the first stage construction work, a comparatively smooth progress had been made until foundation, building and equipment installation while at the stage of piping and electrical instrumentation, a large scaled strike arose. But, with an exception of some remaining work, the construction was completed in March, 1985. And the work in the second stage is estimated as it would be finished in the latter half of 1986. The Australian economy was in a bottom of recession in 82/83 Fiscal Year especially due to the decreased agricultural production, and the government continued the wage-freezing while making a positive financial expenditure, and a remarkable recovery was realized in 83/84 period. In the meantime, reference is made to an Australian labor philosophy: What is important in human life is not labor

but leisure. Like in other Western countries. Accordingly, work outside of the regular working time is subject to a penalty of up to 150 - 300%. The union is divided by job classifications, and in an example in a coal mining enterprize of the Queens Land State, 47 small unions are related. And the solution of labor disputes usually depends on an arbitration system. In Australia, people are generally speaking, not as enthusiastic as in Japan on education, and there is a problem on a general level of the education. (5 figs, 1 tab)

17457 (NP—8770045, pp 84-102) **Fundamental concept of a pilot plant for bituminous coal liquefaction.** Yamamori, Kakunosuke. (Japan Coal Oil Co. Ltd.). 20 Sep 1985. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

In Proceedings of parallel sessions for the 5th NEDO general assembly.

This study was performed as a research funded by NEDO. Japan Coal Oil (NCOL) was established in 1984 to carry out the work as requested by NEDO on plant construction and operation research. In the meantime the research and development of bituminous coal liquefaction technologies in this country has been performed since 1984 by three kind of process: solvent extraction, direct hydrogenation and solvolysis. By consolidating the favorable features of these three process, it was feasible to obtain an internationally high standard pilot plant process. The NEDOL Process developed and unified the three systems is aimed at the most advanced process predominant in the following three points as well as in economy: (1) It is capable of producing a product rich in light distillates and has a high liquid yield. (2) It is applicable to a wide range of coal species from a sub-bituminous coal to a bituminous coal with a low degree of carbonization. (3) The process is a single stage liquefaction accelerating the liquefaction reaction by means of a highly activated ferrous catalyst, and the reaction condition is: pressure = 150 - 200 kg/cm^2, temp. 430 - 460°C. For the R and D it is scheduled that three years are required for each of design, construction and operation so that they make a total of 9 years (complete in 1992 Fiscal Year), and the required funds are estimated to be 100 billion Yen in total (10% to be born by R and D funds of 18 private companies) (5 figs, 1 tab)

17458 (NP—8770046, pp 136-151) **Refining technology of coal liquefied oil and uses of its product. Development of technology for the upgrading of coal liquefied oil and technology for the mixing.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This paper describes the results of research and development for upgrading individual distillates and intermediate distillates en bloc. Coal derived naphtha and petroleum naphtha have been hydrogenated, and the denitrification and desulfurization conditions have been studied. Coal liquefied kerosine and petroleum kerosine have been subjected to independent and mixed hydrogenation experiments, and Ni/Mo groups catalysts found to have better denitrification activity, and mixed kerosine were found to improve denitrification rates. Coal liquefied light oil has been independently experimented for hydrogenation with a result that it seemed hard to make marketable products out of the oil alone. Hydrogenated experiments have been carried out for its mixture with petroleum light oil, and the result has been under analysis. A bench scale plant has been designed and under construction for coal liquefied oil combustion tests. As regards upgrading of intermediate distillates, study of hydrogenation refining conditions, evaluation of commercially available catalysts, study regarding to mixing process with petroleum, analysis of hydrogenated fresh oil and analysis of catalysts have been made. Research will be pursued for further methods of upgrading distillates and en bloc upgrading methods of intermediate distillates and intermediate heavy oil distillates. (16 figs, 4 tabs)

17459 **The specificity of organosulfur removal from coal during molten caustic leaching.** Schmidt, C.E.; Utz, R.; Douglas, L.J. (Pittsburgh Energy Technology Center, P.O. Box 10940, Pittsburgh, PA 15236). pp 143-147 of Proceedings of the 4th annual Pittsburgh coal conference. Greensburg, PA; MEMS (1987). (CONF-870942—).

From 4. annual Pittsburgh coal conference; Pittsburgh, PA, USA (28 Sep 1987).

The presence of sulfur in coal has restricted the direct utilization of coal for electrical power generation owing to the formation of sulfur oxides during combustion of coal. Advanced coal beneficiation processes are being developed to reduce the levels of sulfur and ash in coal before burning it. An emerging technology based on treating coal with molten caustic to remove sulfur and ash is being developed. Initial tests have indicated that greater than 90% of the sulfur and ash can be removed from coal by molten-caustic leaching (MCL). In this investigation, research was undertaken to elucidate the dominant chemical reactions taking place during MCL of coal to remove sulfur, specifically organosulfur compounds. A coal extract was analyzed before and after treatment with molten caustic to examine the chemistry of organosulfur removal. Additionally, the effect of reaction temperature and KOH/NaOH ratio of the molten caustic on the product distributions in coal extracts that have been leached with molten caustic was studied. The product distribution of caustic-treated coal extracts was compared to that of extracts of MCL coals.

17460 **Suppression of carbonate formation during the molten caustic leaching of coal.** Chriswell, C.D.; Shah, N.D.; Kaushik, S.M.; Markuszewski, R. (Fossil Energy Program, Ames Lab., USDOE, Iowa State Univ., Ames, IA 50011). pp 937-943 of Proceedings of the 4th annual Pittsburgh coal conference. Greensburg, PA; MEMS (1987). (CONF-870942—).

From 4. annual Pittsburgh coal conference; Pittsburgh, PA, USA (28 Sep 1987).

Chemical cleaning of coal by molten caustic leaching (MCL) results in removal of over 90% of both sulfur and ash-forming minerals. During the MCL treatment, carbonate is formed resulting in loss of carbon, excessive consumption of caustic, and creation of serious problems during subsequent regeneration of the caustic. In the present work, it has been shown that carbonate levels can be reduced by 40% with rigorous exclusion of air and by an additional 30% when using a pretreatment step consisting of low-temperature devolatilization of the coal prior to leaching. No deleterious effects on product coal quality resulted from these carbonate suppression steps. The yield of coal was reduced somewhat by the devolatilization step, but the reduced yield is compensated for by an increased heat content of the clean coal and by the recovery of energy-rich gases and liquids which are evolved during devolatilization. Preliminary results show that steam purging of the MCL reactor may lead to even greater reductions in carbonate formation.

17461 **(BNL—40281) Formulation of slurries for slurry-fed coal gasifiers: Final report.** Butcher, T.A.; Celebi, Y. (Brookhaven National Lab., Upton, NY (USA)). Mar 1987. Contract AC02-76CH00016. 76p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88004382/JAW.

A 100 MW integrated gasification/combined cycle generating plant was recently put into operation at the Cool Water generating station of Southern California Edison Co. Coal is fed into the gasifier as a coal-water slurry. This report describes an experimental study on the slurryability of candidate gasifier coals and slurry formulation options for use in systems of this type. Relative to boiler and process-fuel applications, the gasifier application has some unique features. The slurry is continuously prepared on-site in wet rod mills and is stored in continuously-agitated day tanks. Stability of the slurry, then, is not a necessity. In addition, economic studies have shown that dispersant additives must be inexpensive (on the order of $.10/million Btu) to be attractive. The ten candidate coals studied ranged in equilibrium moisture from 1 to 13%. The set included Pittsburgh 8 seam coals, Illinois 6 seam coals, and one Utah coal. For three of the coals both run-of-mine and preparation-plant products were examined. Coal characterization included standard analyses, relative hydrophilic/hydrophobic nature, surface area, density, surfactant adsorption, and leachable ions. A ranking was made of the relative slurryability of the coals under two cases, with and without an added surfactant. The ranking, which was based on apparent viscosity at 100 sec^{-1}, was somewhat different in the two cases. As others have reported, equilibrium moisture is a key parameter. Slurry formulation studies included the effects of size distribution, acid leaching, additional physical cleaning (both gravity separation and froth floatation), selected anionic and non-

ionic surfactants, pH, and oxidation to simulate weathering. 17 refs., 27 figs., 25 tabs.

17462 **(CONF-861146—17) A jet-stirred reactor for transient studies of char gasification.** Calo, J.M.; Suuberg, E.M.; Hradil, G.; Perkins, M.T.; Lilly, W.D. (Brown Univ., Providence, RI (USA). Div. of Engineering). 1986. Contract FG22-83PC60800. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004086/JAW.

From AIChE winter annual meeting; Miami, FL, USA (2 Nov 1986).

For some time now in our laboratory we have been using well-mixed, "gradientless" reactors to study the dynamics of gas-carbon reactions. In the past we have used a mechanically-stirred, Berty-type reactor to examine the kinetics of carbon dioxide and steam gasification of chars. More recently, we have been involved in investigating the behavior of "active sites" in certain carbonaceous chars. As a result of the requirements of this work, we were led to the development of a jet-stirred, "gradientless" reactor. The current paper describes the design, development and application of this reactor to char gasification studies. The research project for which the reactor was developed is concerned with the study of the nature and behavior of "active sites" in the gasification of chars produced from synthesized model compounds, primarily those of the phenol-formaldehyde family of resins. One of the tasks defined for this project was to conduct transient kinetic studies on the gasification of these model compound chars, for both unlabelled and ^{13}C-labelled resins. Due to the requirements of the expense of the labelled resins we were led to a design that minimized the relatively large sample requirements of the existing autoclave reactor. Once the necessity for developing a new reactor was realized, it was decided to employ jet-mixing in order to avoid some of the potential complexities of mechanical mixing under the particular operating conditions dictated by the nature of the reaction system. 6 refs., 8 figs., 1 tab.

17463 **(DOE/MC/21004—2411) Expansion of high-temperature, high-pressure data set for coal gasification: Eleventh quarterly report, March 28-June 28, 1987.** Solomon, P.R.; Serio, M.A.; Hamblen, D.G.; Deshpande, G.V.; Kroo, E. (Advanced Fuel Research, Inc., East Hartford, CT (USA)). Aug 1987. Contract AC21-84MC21004. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87006522/JAW.

Five of the nine coal/CO_2 gasification experiments for class 3.G were completed. These involved repeat experiments for the composite factorial matrix and tests which partially overlap the METC matrix. The four remaining experiments are of the latter type. We decided to save these until the end since they will push the high pressure reactor to its limits. Nearly all of the char gasification experiments with AFR chars under class 3.H have been completed and about one-half of those under class 4.F. A set of 5 chars was received from METC to complete the set. Completion of these experiments was delayed by a heating element failure in the reactor system. This has been repaired and the tests are continuing. Char characterization was done on chars received from METC. Measurements were made of N_2 or CO_2 surface area and reactivity. An inventory was taken of all of the char samples produced in our program in order to select additional samples for completing the char characterization and reactivity part of the study. The areas of interest include the effect of minerals, heating rate, molecular order, and CO_2 versus O_2 reactivity. The pyrolysis data for composite factorial matrices with 200 x 270 and 100 x 140 mesh fractions of Montana Rosebud coal was subjected to statistical analysis at METC. In general, the regression model did a good job in predicting yields of the major products, with the exception of water where the data are quite scattered. 3 refs., 9 figs., 3 tabs.

17464 **(DOE/MC/21022—2412) A study of combustion spectra from an entrained-flow gasifier: Final report.** Macek, A.; Charagundla, S.R.; Allen, J.D.; Semerjian, H.G. (National Bureau of Standards, Washington, DC (USA). Center for Chemical Engineering). Oct 1987. Contract AI21-84MC21022. 78p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE87006523/JAW.

The objective of this study was (a) the development of a measurement technique designed to obtain real-time information on several optical emission characteristics from reactors of entrained-flow gasifiers; and (b) demonstration of the applicability of this technique in the field. The gasifier chosen for field demonstration was the Mountain Fuel Resources, Inc. (MFR) pilot plant located near Salt Lake City, Utah. The MFR plant is an oxygen-blown entrained-flow unit with the capacity of 3000 lb/hr of coal at pressures up to 300 psig. The approach chosen in this study was to make simultaneous measurements of optical emission both from the gas and from coal particles in the interior of the gasifier reactor. These measurements were selected because they provide direct information from the reaction zone, and therefore should provide the most rapid response to changes within the reactor. Characterization of gas emission spectra was made by means of an optical multichannel analyzer (OMA) over the spectral range from about 300 to 850 nm. The intensity of continuum radiation from particles was measured at two wavelengths, and used for time-resolved temperature measurements by two-color pyrometry (TCP). The present study confined itself only to the development of the required diagnostic system and the demonstration of feasibility of such simultaneous (OMA and TCP) measurements in the MFR unit. However, the obvious rationale for the choice of this advanced instrumentation was its usefulness for the future development of reliable on-line monitors for gasifiers.

17465 **(DOE/MC/22074—2533) Development of high temperature, high pressure rotating shaft seals: Final report.** Heshmat, H.; Shapiro, W. (Mechanical Technology, Inc., Latham, NY (USA)). Jun 1987. Contract AC21-85MC22074. 211p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88001029/JAW.

Rotating shaft seals used in coal gasification equipment are exposed to difficult environmental conditions including temperature from 430°C to 816°C (800°F to 1500°F), high pressure (to 10 MPa or 1500 psig), and high levels of particulate contamination (50,000 to 100,000 ppM). The program reported upon was designed to develop long-life seals that would not require external flushing or cooling. The approach taken was to develop unbalanced face that would remain closed and prevent particulate entry into the interface. Wear resistant materials and coatings with low friction coefficients are required. Significant results of the program are enumerated: The selected material combination was a rotating runner of Kentanium K162B mating against a non-rotating seal ring of Kentanium K162B. Kentanium is the trade name of a series of hard carbide alloys with pure titanium carbide as the principal ingredient. Nickel and nickel molybdenum are used as binder materials. Kentanium retains most of its strength at temperatures μp to 1100°C (2000°F). Since hard materials are required to resist wear and withstand the temperatures, mechanical compliance must be built into the seal configuration for the opposed faces to follow runner nutations and remain closed. Environmental and frictional heating caused the formation of very small particles of titanium oxide which lodged in the face wave formations and acted as an interfacial lubricant. The results of this program provide encouragement and optimism that dry contact face seals can be developed for long unattended operation in the hostile environment of a coal gasification plant. 40 refs., 98 figs., 20 tabs.

17466 (DOE/METC—86/6043, pp 1-3) **Fossil energy overview of new fuel forms programs.** Swink, D. Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—).

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

This paper compares different methods of commercial coal gasification and the cost benefit analysis associated with each type. The paper is intended to compare why some technologies are economically unsuccessful while others are. It also discusses alternative fuel uses for coal-derived products. The paper concludes with applicability of coal gasification technology in the light industrial and commercial market.

17467 (DOE/METC—86/6043, pp 4-7) **Modeling hydrodynamic mixing in process design and development of fluidized bed gasifiers.** Blake, T.R. (Univ. of Massachusetts, Amherst). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract AC21-85MC22062.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

In this project, models for hydrodynamic mixing in fluidized beds will be used in a representative process design and development scenario for the KRW gasifier. The particular emphasis in this study is upon the use of two modeling approaches: the dimensional analysis and scaling of fluidized data, and the finite difference hydrodynamic model CHEMFLUB. Predictions of hydrodynamic mixing in the KRW reactor will be made. Further, the relative value and practicality of the two different models for predicting hydrodynamic mixing will be assessed.

17468 (DOE/METC—86/6043, pp 8-16) **Utilization of the S-cubed, entrained-flow coal gasification model (EFCG).** Hill, S.C. (Los Alamos National Lab., NM). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—).

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

This paper is designed to evaluate and apply the DOE/EPRI-supported entrained-flow coal gasification code (EFCG) [developed by Systems, Science, and Software (SCubed)] to assess the accuracy and utility of the code. This will include examining the individual submodels for applicability accuracy, and stability; comparing model predictions with analytical solutions and laboratory measurements; applying the code to industrial gasification systems; and documenting it to enhance code utility for a diverse group of potential users.

17469 (DOE/METC—86/6043, pp 17-23) **Injection of densely loaded flows into entrained-flow gasifiers.** Rizk, M.; Morrison, C. (Science Applications International Corp., Chatsworth, CA). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract AC21-85MC22064.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The overall objective of this project is to develop an improved understanding of the injection and mixing of densely loaded gas/solid mixtures into gas streams. The ultimate application of the results will be the development of improved injection and mixing configurations for entrained-flow coal gasifiers.

17470 (DOE/METC—86/6043, pp 24-36) **Technical support analysis of coal gasification processes.** Shinnar, R. (City College of New York, NY). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract AC21-84MC21259.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The goal of the contract is to provide METC with studies indicating the potential of various coal gasification processes under development. The work uses methods developed by the investigator under a previous contract. The method focuses on identifying and analyzing the process constraints of a proposed process concept and evaluates their economic impact in comparison with available technology. Such differential economic and technique evaluation allows a more reliable estimate of the economic value of new technology, and pinpoints the problems that have to be solved to make a new concept attractive. The work under this contract deals both with the study of the impact of gasifier design and coal properties on these constraints as well as with the application of the method to specific gasification processes chosen by DOE with special emphasis on fluidized bed gasifiers.

17471 (DOE/METC—86/6043, pp 37-45) **Catalytic gasification of chars or carbon.** Heinemann, H. (Lawrence Berkeley Lab., CA). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract AC03-76SF00098.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The major purpose of this project is to find catalysts which will permit steam gasification of carbonaceous material at reasonable rates and at lower temperatures than currently practiced. An understanding of the catalytic mechanism is necessary to provide leads toward this aim and are discussed in this paper.

17472 (DOE/METC—86/6043, pp 46-62) **Fundamental mechanisms of coal gasification.** Howard, J.B.; Peters, W.A. (Massachusetts Institute of Technology, Cambridge). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—).

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The overall objective of this research is to advance current understanding of coal physics and chemistry to the point where reliable predictions of coal devolatilization behavior under gasification conditions can be made with confidence. The specific objectives are to: (1) study the role of intra-particle chemical kinetic and transport rate phenomena in coal devolatilization; (2) experimentally determine how coal type influences coal devolatilization behavior including the following phenomena: product yields, compositions and evolution kinetics; intra-particle secondary reactions of tar; extra-particle secondary reactions of tar; and the plasticity of softening coals; (3) to develop an integrated mathematical model of coal devolatilization under coal gasification conditions. Work on Task 1 has just recently begun, and activities on Task 3 have been generally of a preliminary and preparatory nature. Progress on Task 2 will be the emphasis of this presentation. The objectives are: (A) to measure rates and extents of evolution of individual products from rapid devolatilization of six different coal types; and (B) to relate these data and pertinent literature information on product yields and evolution kinetics to coal type.

17473 (DOE/METC—86/6043, pp 63-74) **Advanced studies on rapid coal devolatilization.** Steinberg, M.; Fallon, P.T.; Sundaram, M.S. (Brookhaven National Lab., Upton, NY). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—).

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The purpose of this program is to obtain a better understanding of the mechanism and provide basic process chemistry information relating to the rapid devolatilization of coal. This program consists of three parts: (A) Molecular Process Studies, (B) Completion of Studies on Flash Pyrolysis of Coal with Reactive and Non-Reactive Gases, and (C) Exploratory Work. Although a large body of literature exists on the fundamentals of coal pyrolysis, the independent and interactive influence of temperature, pressure, and heating rate have not been studied in a systematic manner. Furthermore, a detailed characterization of the tar, which is a primary precursor of devolatilization, has not been determined. Their approach is to resolve the chain of events in the devolatilization of coal by a flow-through fixed bed method, using a pyroprobe directly interfaced with a GC/MS to obtain qualitative and quantitative data from the pyrolysis of coals.

17474 (DOE/METC—86/6043, pp 92-101) **Reaction kinetics and physical mechanisms of ash agglomeration.** Carty, R.H. (Institute of Gas Technology, Chicago, IL). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—).

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The ultimate aim of the IGT research program in ash chemistry is to be able to predict the behavior of the mineral matter in a fluidized-bed gasifier and its downstream units based on a minimum analysis of the characteristics of the mineral matter present in the coal feed and the operating conditions. The present research program addresses the key issues of ash particle contact, conditions and rates of reaction of mineral matter, and agglomeration conditions in fluidized-bed gasification. The specific objectives of this investigation are: (1) to determine the effect of coal mineral matter variation on the behavior of ash in fluidized-bed gasification, and to correlate this behavior to a detailed petrographic analysis of the

mineral matter present in the coal; (2) to determine the reaction rates of individual clays and silica with the pyrite and carbonates of coal as a function of temperature, pressure, and gas composition; (3) to determine the feasibility of employing the dielectrophoretic manipulation technique to identify the conditions under which colliding ash particles coalesce, shatter, or deposit.

17475 (DOE/METC—86/6043, pp 161-170) **Entrained-flow reaction studies in the METC advanced gasification facility.** Bissett, L.A. Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—).

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The objective of this work is to determine and model the effects of gasification environments on product yields over a broad range of mild to severe conditions. Tests are conducted in a 3-inch ID, downflow entrained reactor that can achieve gas preheat temperatures and reaction temperatures of 3000°F and 2500°F, respectively, and be operated up to 900 psig pressure. A comprehensive test program with Montana Rosebud subbituminous coal is being conducted. The program is organized into major test classes to study coal in inert steam and carbon dioxide environments, and an additional one to investigate gasification reactions of some of the char produced during the test program. A composite factorial experimental design is used within some of the classes to investigate the effects of reaction temperature, pressure, and gas residence time. This enables a wide range of conditions to be studied with 15 different tests and permits the use of response surface and statistical techniques for data analyses. The variable levels and respective codes are given in Table 1. Trends predicted by some of the statistically significant regression models that resulted from the Class 3A composite factorial pyrolysis test series have been presented and discussed.

17476 (DOE/METC—86/6043, pp 171-181) **Expansion of high-temperature, high-pressure data set for coal gasification.** Jenkins, R.G.; Scaroni, A.W. (Pennsylvania State Univ., University Park). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract AC21-84MC21376.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The primary objective of this investigation is to provide a complementary study to those being undertaken by METC and Advanced Fuels Research Corp. in the area of high-pressure, high-temperature coal devolatilization/gasification. This investigation will extend the data base into shorter residence times (< 1s) to study phenomena of early coal devolatilization. The effects of coal rank, coal pretreatment and gaseous atmosphere on coal devolatilization under pressure are also to be investigated.

17477 (DOE/METC—86/6043, pp 182-191) **Expansion of high-temperature: high pressure data set for coal gasification.** Serio, M.A.; Hamblen, D.G. (Advanced Fuel Research, Inc., East Hartford, CT). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract AC21-84MC21004.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The program has three major objectives: (1) determination of chemical kinetic rates for pyrolysis. (2) Investigation of the relationship between char reactivity and char formation conditions, particularly with regard to heating rate. (3) Investigation of the effect of pressure on pyrolysis and gasification reactions. This project is complementary to one being conducted with the METC Advanced Gasification Facility (AGF) entrained reactor using the same coal (Montana Rosebud subbituminous). It has expanded the data matrix to include conditions which do not require the capabilities of that facility. The ultimate goal of the combined AFR/METC program is to supply a data base, understanding and predictive capability which can lead to improved gasification systems.

17478 (DOE/METC—86/6043, pp 201-210) **Entrained flow gasification at elevated pressure.** Smoot, L.D.; Hedman, P.O.; Smith, P.J. (Brigham Young Univ., Provo, UT). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract AC21-85MC22059.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The general objectives of this program are to develop a basic understanding of the physical and chemical processes involved in entrained coal gasification and to incorporate results in a model of the gasification process. Key specific objectives are to: (1) provide data from the laboratory gasifier at elevated pressure with variation in coal type, feed composition and injector configuration on conversion efficiency and product composition; (2) provide and document detailed basic profile data for reactive and non-reactive flows to illucidate basic reaction processes and to evaluate process models; (3) develop and evaluate a comprehensive model for predicting detailed features of entrained coal gasification; and (4) promote transfer of new technology through publications, workshops, and code placement. Successful completion of this investigation can provide: (1) reliable correlations of carbon conversion, product gas composition, and pollutant emissions from controlled laboratory experiments for use in design of gasifiers assessment of effects of key variables; (2) a generalized predictive method for entrained gasification to assist in gasifier design, test planning, data evaluation and process optimization; (3) identification of phenomena that control the gasification process which will provide insights into process design and modification for control of carbon conversion, emission levels, or other desired results. This is thought to be the only ongoing gasification study where measurements are made locally within a gasifier and where results are compared with a generalized predictive method.

17479 (DOE/METC—86/6043, pp 225-234) **Gas separation by pressure swing adsorption for producing hydrogen from coal.** Yang, R.T. (State Univ. of New York, NY). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract AC21-85MC22060.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The objective of this contract is to develop a zeolite pressure swing adsorption (PSA) process to be used for the production of hydrogen from coal gasification products. Low-energy, economical gas separation processes are required as alternatives to energy-intensive and costly technologies such as cryogenic distillation and wet scrubbing for gasification products to produce hydrogen from coal. Gas separation and acid gas removal processes currently constitute a significant fraction of the total cost of hydrogen production from coal. Gas separation and acid gas removal processes currently constitute a significant fraction of the total cost of hydrogen production from coal. SUNY has demonstrated that PSA processes using activated carbon offer the potential for an economic separation of hydrogen from gas mixtures similar in composition to gasification products. Adsorption of gases on zeolites, as compared to activated carbon, have higher selectivities toward certain gases, and give better separations and products of higher purity. High-purity hydrogen (99.999%) is required by an increasing number of industries such as electronics, semiconductors and metal treating industries. Such a high-purity hydrogen can only be produced by using zeolite as the sorbent.

17480 (DOE/METC—86/6043, pp 235-244) **Low temperature, sulfur tolerant, homogeneous catalysts for the water-gas shift reaction.** Laine, R.M.; Wood, B.J.; Krishnan, G.N.; McCarty, J.G.; Schwaar, R.H. (SRI International, Menlo Park, CA). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract AC21-85MC22065.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

In long term planning for energy resources and chemical feedstocks, hydrogen derived from steam gasification of coal may become an important alternative to hydrogen obtained from steam reforming of natural gas. The production of additional hydrogen

from syngas by WGSR substantially enhances the yield of this product. Thus, a potentially important route to improving the economy of hydrogen production is to enhance the efficiency of industrial water-gas shift reaction (WGSR) catalysis. The objective of this project is to identify, prepare, test, characterize, and evaluate a practical, homogeneous catalyst for the production of hydrogen from coal gas by the water-gas shift reaction.

17481 (DOE/METC—86/6043, pp 245-254) **Management of coal waste by energy recovery: mild gasification/flash pyrolysis of coal wastes.** Chu, C.I.C.; Im, C.J.; Gillespie, B.L. (UCC Research Corp., Bristol, VA). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract AC21-84MC21108.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The general objective of the contract is to use low cost feedstocks (such as the literally free coal waste) and a technically simple (low severity conversion of coal) process to produce good quality coal liquids requiring little or no additional processing for use as motor-type fuels and heating oil. The process being proposed is the Mild Gasification Process, which is a low temperature, and low-pressure carbonization process. The scientific basis underlying this type of process is well documented in the literature. Its basic concept is to skim the high quality volatile matter as liquids from coal and produce a char with enough volatile material remaining to facilitate easy burning of the char in an industrial furnace. Thus far, the work accomplished at UCCRC indicates the possibility that the Mild Gasification process may be the simple and economic process that is needed to solve their Nation's energy and environmental problems mentioned above.

17482 (DOE/METC—86/6043, pp 255-264) **KRW process development unit (PDU) fluidized-bed coal gasification/hot gas cleanup.** Haldipur, G.B.; Kim, S.; Lucas, J.L. (KRW Energy Systems Inc., Madison, PA). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract AC21-84MC21063.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The goal of the technology development at KRW technology is to provide the electric utility industry with an advanced technology for integrated combined cycle power plants that has a low installed cost, a competitive heat rate and superior environmental acceptability and can be added in manageable increments. The specific objectives of the Waltz Mill process Development Unit (PDU) operation are: (1) to demonstrate operability of two complementary hot gas sulfur removal systems: gasifier in-bed desulfurization with a calcium based sorbent and external bed desulfurization utilizing a zinc ferrite sorbent, (2) to demonstrate hot particulate collection/removal technology, and (3) to characterize levels of particulate, ammonia, alkali and sulfur emissions from coal gasification as necessary to meet the requirements for power generation and environmental standards.

17483 (DOE/METC—86/6043, pp 265-273) **Experimental evaluation of the steady-state and dynamic performance characteristics of the interactive units of a coal gasification process.** Furman, A.H.; Kimura, S.G.; Shah, R.P.; Smith, D.P. (General Electric, Schenectady, NY). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract AC21-80ET14928.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

Coal gasification/gas cleanup fuel plants have been identified as being viable coal to electricity concepts when integrated with gas turbine power generation systems. One specific concept was selected to establish a realistic experimental simulation of the total system. This concept consisted of an air-blown gasifier, a gas cleanup system, and a gas turbine/steam turbine combined cycle power generation system connected to a utility grid. A design for this coal conversion system was developed in a full-scale plant layout for a previous program. An experimental facility, developed to match the technical detail of this full-scale design, was constructed and checked out prior to initiation of the current program. During the first portion of this program, technical information was generated on the performance of both the components and the total system. An assessment of the dynamic operation of the fuel plant in response to simulated utility grid transients was made. This type plant was determined to have excellent response characteristics. The focus of the program was then shifted to evaluate techniques which could simplify the integrated gasification combined cycle (IGCC). The experimental facility was modified to permit evaluation of a simplified IGCC concept with hot gas cleanup. In order to define the characteristics of the various simplified IGCC options, a study was initiated to develop performance and economic information on full-scale plants on a consistent basis.

17484 (DOE/METC—86/6043, pp 274-282) **Status report on KILnGAS commercial module.** Enright, F.J.; Garside, P.G.; Johnson, B.T. (Allis-Chalmers Coal Gas Corp., Milwaukee, WI). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract FC21-85MC22146.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The overall RAM program objective is to operate the KILnGAS Commercial Module (a 600-ton-per-day low-Btu coal gasification plant) as necessary to obtain data sufficient to verify commercial performance expectations and provide a basis for commercial process and equipment design. The KILnGAS process is an emerging technology for producing clean, gaseous fuel from coal or other carbonaceous materials. The product gas is a low-Btu fuel (nominally 150 Btu/SCF) that is especially well suited for large volume applications principally founded in the electric utility industry. The KILnGAS Commercial Module is a 600-ton-per-day commercial scale coal gasification plant designed to demonstrate and test the KILnGAS process. Located on the site of the Illinois Power Company's Wood River Generating Station in East Alton, Illinois, the plant is designed to supply approximately 400 million Btu per hour of product gas to the utility's 50-MW steam boiler. The specifics of design and operation of this plant are discussed.

17485 (DOE/METC—86/6043, pp 283-294) **Production of alternative fuels by low-temperature, low-pressure coal conversion.** Esterson, G.L.; Aizenshtat, Z.; Pismen, M.; Kalson, P. (Hebrew Univ. of Jerusalem, Israel). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—).

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The overall goal of the project is to explore the intra- and extra-particle chemistry, mass transfer, and energy transfer which occur during conversion of US eastern high sulfur bituminous coal in a split-stage, fluidized-bed reactor of innovative design. Particular attention will be paid to sulfur chemistry. These data for coal will be compared with similar data from the same reactor fueled by high sulfur eastern US and Israeli oil shales. The project objectives are as follows: (1) maximize overall production of alternative fuels; (2) maximize economic feasibility of the process; (3) optimize the mix of alternative fuel products; (4) maximize conversion of coal to useful products; (5) maximize sulfur removal inside reactor; (6) minimize energy losses in the process; (7) minimize waste materials problems associated with water, solids, and flue gas; (8) minimize pollution problems.

17486 (DOE/METC—86/6043, pp 295-310) **Mechanisms and characterization of mild gasification processes.** Khan, M.R. Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—).

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The aim of the study reported here was to optimize product quality by use of relatively mild conditions. Low-temperature devolatilization of coal in the presence of CaO can produce a relatively high-quality liquid fuel. The H/C ratio of the liquids generated in such a relatively simple devolatilization system varies between 1.3 and 1.5 for high-volatile coals. The presence of CaO in the fuel bed markedly reduces H_2S in the gas phase and decreases sulfur and oxygen heteroatoms in the liquids. The liquid produced in the presence of CaO has fewer phenolic and aromatic compounds than that produced in the absence of CaO. It is suggested, based on this study and on available data, that basic CaO may interact with the

phenolic compounds, forming hydrocarbon salts that decompose, leading to reduced phenol or aromatic content of the pyrolysis liquid. The resulting high-quality liquid fuel produced in this simple operation may serve as a transport fuel in certain applications without requiring further significant upgrading, or as an octane-booster additive to existing transport fuels.

17487 (DOE/METC—86/6043, pp 311-320) **Entrained-flow reaction studies din the METC advanced gasification facility.** Bissett, L.A. Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—).

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The objective of the entrained-flow reaction studies at the Morgantown Energy Technology Center (METC) is to determine and model the effects of gasification environments on product yields. The research uses a 3-inch I.D., down-flow entrained reactor that turbulently mixes preheated gases with coal to achieve high particle heating rates. As part of a comprehensive experimental program, a composite factorial test series with steam and Montana Rosebud subbituminous coal sized 200 x 270 mesh was completed. Trends predicted by the statistically significant regression models, in conjunction with the results from the pyrolysis test series, may improve the understanding of heterogeneous reaction rates, enhanced char reactivity, and volatiles stabilization reactions. Since the regression analyses have not been completed for the steam test series, this paper presents some of the data in tabular form, discusses some of the readily identifiable effects of the reaction variables, and compares some of the steam test data with the pyrolysis test data.

17488 (DOE/METC—86/6043, pp 321-330) **METC fixed-bed gasification system.** Pater, K. Jr. Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—).

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The US Department of Energy (DOE), Morgantown Energy Technology Center (METC), set out to identify design features which would enable a fixed-bed gasifier to operate on the full range of US Coals. In addition, an advanced concept for product gas stream treatment was originated and demonstration of its viability was the major objective of this work. This has resulted in an integrated test facility focused on the METC stirred fixed-bed gasifier with both air- and oxygen-blowing capabilities. The METC fixed-bed gasifier is a Wellman-Galusha type extensively modified to operate at pressure up to 300 psig, to operate with a deep bed stirrer for processing highly caking coals, and to be controlled and acquire data via automatic systems. The system features a novel dry tar full-flow gas cleanup system that sequentially removes dust, tars, oils, light hydrocarbons, water containing ammonia and phenols, and elemental sulfur in separate manageable effluent streams, thus enhancing further stream treatment, disposal, or recycle usage. Sulfur removal is accomplished through first-of-its-kind pressurized Holmes-Stretford desulfurizer plant that converts the hydrogen sulfide in the gas stream to an elemental sulfur cake while operating directly on the fuel gas. Product gas can be extracted after any stage of cleaning to satisfy a variety of end uses.

17489 (DOE/METC—86/6043, pp 331-340) **Mild gasification systems analysis.** Stefano, J.M. Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—).

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

Reentry of coal into the transportation, light industrial, commercial, and institutional sectors will require the development of a broad spectrum of convenient, environmentally acceptable, and economical coal-based fuel forms. Mild gasification, one option to produce these alternative fuels forms, revisits coal devolatilization to explore the feasibility of using this technique to produce fuels in simple, low-cost systems. DOE is currently sponsoring research on a number of different approaches to mild gasification, all designed to improve the quality and/or quantity of the condensable product. These approaches include conditioning the coal or conducting the devolatilization process in reactive atmospheres or in the presence of a sorbent material. METC's systems analysis project is currently assessing the technical performance, economics, and environmental consequences of one mild gasification approach to provide research guidance for the program.

17490 (DOE/METC—86/6043, pp 351-357) **Pyrolysis and devolatilization.** Ross, S.F. (Univ. of North Dakota, Grand Forks). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—).

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The primary objective of this project is to develop an experimental test which will simulate the production of water-soluble organic effluents from a gasifier. Such a test would allow for the assessment of potential downstream effluent treatment without having to produce waste water on the pilot plant scale. A second objective of the project is to correlate the yields of water-soluble organics to specific pyrolysis conditions and coal types using the data generated by the above experimental test.

17491 (DOE/METC—86/6043, pp 386-390) **Development and commercialization of the Texaco Coal Gasification Process June 24, 1986.** Siegart, W.R. (Texaco Inc., White Plains, NY). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—).

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

This paper discusses the historical development of the Texaco Coal Gasification Processes along with the current and future uses of this process. It discusses the current on-line gasification plants which use this process and the economic analysis associated with competition with non-coal gasification utility and power plants. It then discusses future applications which are developing as a result of clean air regulations and impacts on non-gasification plants.

17492 (DOE/METC—87/6079-Vol.1, pp 1-13) **Status of coal gasification technology and its implications for electric power production.** Alpert, S.B. Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

During the past 10 years or so, the Electric Power Research Institute (EPRI) has been carefully assessing and selectively developing/demonstrating a number of coal gasification technologies for use within the US electric power industry. In parallel, EPRI began engineering and economic analysis of alternative coal gasification technologies to determine the economic potential of coal gasification coupled to combustion turbine combined-cycle power plants. This paper briefly summarizes the present status of key emerging second-generation coal gasification processes which show promise of producing economically competitive power when coupled to the next generation air cooled combustion turbine combined-cycle technology. Since nearly all IGCC plants rely on the availability of this advanced combustion turbine, the paper also briefly reviews the status and performance of the next generation combustion turbine combined cycle. The major leading emerging coal gasification systems which are reviewed are (1) Texaco Partial Oxidation, (2) the DOW Syngas Process, (3) the British Gas-Lurgi Slagging Gasifier, (4) the Shell Coal Gasification Process, (5) the Allis-Chalmers KILnGAS Technology, and (6) the High Temperature Winkler Fluid Bed. All of these processes have been or are operating at scales of at least 200 tons/day and existing data provide a firm basis for estimating future commercial plant performance. 11 tables.

17493 (DOE/METC—87/6079-Vol.1, pp 14-23) **Development of a mild gasification process.** Chu, C.I.C.; Im, C.J.; Gillespie, B.L. (UCC Research Corp., Bristol, VA). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1). Contract AC21-87MC23289.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objective of this research and development program is to develop a mild gasification process which produces the quantity and quality of condensibles, char, and gas that makes the process

economically feasible. This project involves: (1) modifying the existing Mild Gasification Process Development Unit (MGU) at UCC Research Corporation (UCCRC), (2) conducting extensive parametric tests with the modified MGU to obtain detailed information on the mild gasification process with a view to finding the optimum operating conditions, and (3) conducting experiments to determine the suitability of char for several commercial applications. The data will be analyzed to recommend the next stage of development and to determine the best approach for commercialization. Only the first phase has been completed so far. Modifications to the process development unit are described. 15 references.

17494 (DOE/METC—87/6079-Vol.1, pp 24-33) **Steam conditioning of coal for synfuels production.** Graff, R.A.; Zhou, P.; Brandes, S.D. (City College CUNY, New York, NY). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1). Contract AC21-87MC23288.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

Steam conditioning of coal and its subsequent mild gasification is being studied in bench scale equipment. Three coals will be tested in these studies: Illinois No.6, Kentucky bituminous (Wellman blend), and lignite (Mississippi). Initially, the effect of process conditions on product yields will be examined. In steam conditioning, pressure will be varied from one to 50 atmospheres and temperature from 300 to 400°C. Effectiveness will be evaluated by extraction of conditioned coal with pyridine at room temperature. This will be followed by a study of the effect of process conditions on yields from conditioned coal in the mild gasification step. In these tests, the semicontinuous reactor, modified to accommodate steam, will be used. For the preparation of larger quantities of condensable product for testing and characterization, a continuous mild gasification test facility is being constructed. This is comprised of a fluid bed reactor for the rapid heating in steam of 2.5 lbs. of coal per hour. A variety of analytical procedures are being used to characterize conditioned coal in addition to condensables and char. This information will be interpreted in terms of physical and chemical processes occurring in coal during steam conditioning. These results will be used to project conditions for the optimum production of hydrocarbon product. Preliminary results are discussed. 5 references.

17495 (DOE/METC—87/6079-Vol.1, pp 34-42) **Investigation of reactions of heteroatoms during coal gasification.** Zabransky, R.F.; Stock, L.M. (Institute of Gas Technology, Chicago, IL). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1). Contract AC21-85MC22063.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The principal objective of this research program is to determine the key reaction pathways that lead to the formation of the oxygen-, sulfur-, and nitrogen-containing products formed during the gasification of subbituminous and bituminous coals. The program utilizes a new approach for the assessment of the nature of the product-forming reactions occurring during pyrolysis. It involves modifying the coals in a specific way by a designed synthesis. When appropriate, isotopic labels can also be introduced into the structure. This approach enables the relationship between the structure of the coal and the product to be accurately determined. Most important, the reaction chemistry of the selected structural element can be examined in the environment of real coal molecules. The structural elements to be studied are sulfur heterocycles, thiols, basic and non-basic nitrogen compounds, carboxylic acid derivatives, phenols, ethers and other carbonyl derivatives. The coals to be modified and subsequently gasified are Illinois No.6 and a lower rank, oxygen-rich subbituminous coal. Preliminary results are given. 7 references.

17496 (DOE/METC—87/6079-Vol.1, pp 43-52) **Measurement and modeling of advanced coal conversion processes.** Serio, M.A., Hamblen, D.G.; Yang, D.B.; Brewster, B.S. (Advanced Fuel Research, Inc., East Hartford, CT). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1). Contract AC21-86MC23075.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The overall objective of this program is the development of computer-aided reactor engineering technology for the design, scale up, simulation, control and feedstock evaluation in advanced coal conversion devices. To accomplish this objective, the study will: establish the mechanisms and rates of basic steps in coal conversion processes, integrate and incorporate this information into comprehensive computer models for coal conversion processes and, evaluate these models and apply them to gasification, mild gasification and combustion in heat engines. This paper highlights the progress which has been made in the following areas: ignition and soot formation; particle optical properties; selection of an approach for incorporating the detailed Advanced Fuel Research coal devolatilization model into a comprehensive two-dimensional reactor model; and review of existing fixed-bed models. 10 references.

17497 (DOE/METC—87/6079-Vol.1, pp 66-75) **Novel concept development of an internal recirculation catalyst for mild gasification.** Anderson, G.L.; Solka, B.H. (Institute of Gas Technology, Chicago, IL). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1). Contract AC21-86MC23057.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

One of the primary economic penalties of catalytic coal gasification processes is in recovery of added catalyst from the spent char. In the process concept addressed in this work, a catalyst is used that is semivolatile under gasification conditions. That is, for a gasifier that utilizes an increasing thermal gradient from feed coal inlet to char discharge, a desirable catalyst would be sufficiently volatile at the higher temperature to be completely vaporized from the char before it is discharged. The catalyst vapor would then recirculate and condense on the cooler feed coal. The first stage of this program has been laboratory-scale examination of the effect of CsOH on volatile product nature and quantity. Tests of catalyst at heat-up rates of 210°F/sec and 390°F/sec to final temperatures of 1000°F and 1400°F have been completed for Illinois No.6 coal in helium and partially completed for Illinois No.6 coal in 8.6% by volume of H_2 in He and Wyodak coal in He. Testing of North Dakota Lignite in these atmospheres and Illinois No.6 in He/H_2O(g) is planned. In addition to product quantities, examples of important product parameters being examined for catalyst effect are disposition of sulfur among the products and degree of aliphatic nature of condensible product liquids. Results from these laboratory pyrolysis on-line analysis tests are being used as a guide in defining operating conditions, product collection schemes, and product analysis plans for the bench-scale tests.

17498 (DOE/METC—87/6079-Vol.1, pp 76-85) **Chemical and physical development of char particles during devolatilization.** Hamblen, D.G.; Serio, M.A. (Advanced Fuel Research, Inc., East Hartford, CT). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1). Contract AC21-85MC22050.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objective of this project is the acquisition of fundamental data and its use to develop improved predictive models for the physical and chemical behavior of coal in a gasifier. This is being accomplished through a combined theoretical and experimental program focusing on the thermal, optical, physical, and reactive properties of coal and char. During the past year, the project has emphasized the measurement of coal optical properties and char reactivity and the development of a general pyrolysis model. These topics are discussed. 27 references.

17499 (DOE/METC—87/6079-Vol.1, pp 100-109) **Mild gasification of coal.** Fallon, P.T.; Sundaram, M.S. (Brookhaven National Lab., Upton, NY). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objective of this program is to conduct research and development on the mild gasification concept for Eastern coals for

the purpose of determining (1) the process chemistry, (2) the yield of liquid, gas, and solid co-products, and (3) the quality of liquid product. Mild gasification of coal is defined in terms of process conditions of temperatures below approximately 750°C, pressures below approximately 50 psig, and coal residence times up to a number of minutes. In the mild gasification, the internal stoichiometry of the coal provides the needed hydrogen. The primary problem at present is to determine the yields and quality of products as a function of the process conditions in a system that would be amenable to scale up to a full-scale continuous process. It is, thus, the purpose of this program to run a bench scale unit of sufficient capacity to obtain product yield and product quality data as a function of process conditions. Results to date are discussed.

17500 (DOE/METC—87/6079-Vol.1, pp 110-116) **Fundamental mechanisms of coal gasification.** Howard, J.B.; Peters, W.A. (Massachusetts Institute of Technology, Cambridge). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The overall objective is to advance current understanding of coal physics and chemistry to allow improved, quantitative predictions of coal devolatilization behavior under gasification conditions. The specific objectives are to: (1) study the role of intra-particle chemical kinetic and transport rate phenomena in coal devolatilization; (2) experimentally determine how coal type influences coal devolatilization behavior including the following phenomena: product yields, compositions and evolution kinetics; intra-particle secondary reactions of tar; extra-particle secondary reaction of tar; and the plasticity of softening coals; and (3) develop an integrated mathematical model of coal devolatilization under coal gasification conditions. Results from work on the first and second tasks are discussed. 6 references.

17501 (DOE/METC—87/6079-Vol.1, pp 165-169) **Experimental development of a multi-solid fluidized-bed reactor concept.** Steedman, W.G. (Battelle Columbus Lab., OH). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

Battelle's two-stage Multi-Solid Fluidized Bed (MSFB) Gasification process represents an advanced combined cycle power generation system. The MSFB is a high-throughput gasifier which produces a medium-Btu gas without requiring an oxygen plant. Elimination of an oxygen plant is a major process simplification and cost reduction. The product gas is of sufficient quality that it can replace natural gas without extensive modifications to existing combustion equipment. The objective of the proposed experimental program is to prove the feasibility and quantify the performance of the MSFB gasification system. Development of this advanced coal gasification system is directed toward meeting the needs of the utility industry for an economical, environmentally acceptable and flexible technology. A series of progressive experiments are planned to provide performance data to be used in a process technical and economic evaluation. No results are available as yet.

17502 (DOE/METC—87/6079-Vol.1, pp 170-182) **Mechanisms of mild gasification and low severity coal devolatilization.** Khan, M.R. Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objective of this study is to investigate the influences of relatively mild operating conditions (e.g., heating rate) on products quality/yield by comparing devolatilized products obtained at a range of temperatures and heating rates. A slow heating rate organic devolatilization reactor was used to obtain liquid and solid products at a mild heating rate to a range of final temperatures. The rapid rate liquid products were obtained using either a fluid-bed reactor or an entrained-flow system. The liquids generated at mild and severe conditions are being characterized by a number of techniques (Field Ionization Mass Spectroscopy, Sequential Elution Solvent Chromatography, Fourier Transform Infrared Spectroscopy, Elemental Analysis, etc.). At a rapid heating rate, the yields of heavier polyfunctional groups are markedly greater compared to that obtained at a slow rate. The liquids generated at a slow heating rate are of lower molecular weight, viscosity, sulfur content, but of higher H/C atomic ratios compared to the liquids obtained at a rapid rate. The effect of increasing the maximum devolatilization temperatures (at a constant slow heating rate) was to increase the yield of light gases (mainly H_2) at the expense of char hydrogen content. The tar yield is not markedly influenced when the peak devolatilization temperature is increased. However, the quality of the liquids or the reactivity (in air) of the product char was reduced when the peak pyrolysis temperatures were increased. It is proposed that at a rapid rate, the primary products, representative fragments of the parent coal structure, are devolatilized and, therefore, are of poorer quality. At a slow heat-up rate, however, the primary coal fragments undergo additional cracking reactions forming low molecular weight hydrocarbons of relatively higher quality.

17503 (DOE/METC—87/6079-Vol.1, pp 183-186) **Mild gasification of coal.** Ness, R.O. Jr.; Willson, W.G. (Univ. of North Dakota, Grand Forks). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

For coal to become more marketable, specific areas need to be targeted in which coal products, such as char and coal-derived liquids, are not in direct competition with oil or natural gas. These areas, in the case of mild gasification, can be grouped into three areas: (1) solids; (2) condensables; and (3) gases. Auxiliary equipment for handling char and condensables will be designed and fabricated. An upgraded hot cyclone and quench system will be constructed and retrofitted on the pressurized fluid-bed gasifier (PFBG). This is necessary because the operating temperatures are lower than the original design. The PFBG will be used to perform a preliminary process evaluation. The screening will evaluate yields versus residence times (seconds to 20 minutes), temperatures (1000 to 1350°F), pressures (atm. to 50 psi), steam-to-carbon ratio (1:1 to 4:1), and coal variability (lignites and bituminous). Preliminary results are given.

17504 (DOE/METC—87/6079-Vol.1, pp 187-199) **Gasification systems analysis.** Klara, J.M.; Gessner, A.W.; Hand, T.J. Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The major objective of the Gasification Systems and Analysis project at the Morgantown Energy Technology Center (METC) is to identify feasible gasification systems by providing in-house, computer-based systems analysis expertise. As a continuing effort, this project is investigating various process alternatives for a commercial-scale mild gasification process which produces a suite of solid, liquid, and gaseous fuels from a devolatilization system operating at relatively low temperature (1000-1200 degrees F) and pressure (1-2 atm). As a new effort in this project, several alternate configurations for the production of hydrogen fuel from a coal gasification-based system are being evaluated. These configurations focus on the utilization of novel processes for gasification, water-gas shift catalysis, gas separation, and gas purification. Using the Advanced System for Process ENgineering (ASPEN) process simulator to determine mass and energy balances and by performing capital and operating cost estimates, these gasification-based systems are being evaluated for their technical and economic merit.

17505 (DOE/METC—87/6079-Vol.1, pp 200-203) **Fundamental research on mild gasification char fuel development.** Chu, C.I.C.; Im, C.J.; Gillespie, B.L. (UCC Research Corp., Bristol, VA). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1). Contract AC21-87MC23290.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The primary objective of this project is to develop a novel process for upgrading the char produced in the mild gasification process in order to enhance the economic advantages of mild gasification. The project involves: (a) designing, constructing, and testing

a bench-scale char chlorination units; (b) if bench-scale tests are successful, designing, constructing and testing a char chlorination process development unit (PDU); and (c) conducting gas turbine and carbon electrode application studies with the cleaned (chlorinated) char from the PDU. Data from the preliminary char chlorination tests are given.

17506 (DOE/METC—87/6079-Vol.1, pp 210-214) **Component systems enhancement: reduced girth seam weldments for heavy-walled vessels.** Horacek, D.R.; Peters, S.W. (CBI Na-Con, Inc., Oak Brook, IL). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1). Contract AC21-86MC22068.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objective of this contract is to evaluate by design, analysis and testing three different configurations for the reduced thickness area. The detail that has proven to be the most technically merited has been evaluated to determine the vessel cost savings for implementing the design details. This concept results in an overall vessel cost reduction of 9.5% for a typical gasification vessel. Construction schedule savings will also be estimated and resulting finance cost savings for a gasification plant will be estimated. A qualitative estimate for the overall plant cost savings for a plant using larger vessels (as made practical by this research) and therefore, fewer process trains will be made. The following portions of the research have been completed: ADINA nonlinear analysis of the three models to predict failure pressures; fabrication and testing to failure of all models; comparison of analysis predictions vs actual test results, (the models with the enhancement failed within 2% of a standard vessel); and estimated cost savings of 9.5% for heavy-wall vessels utilizing this concept. The project description and future plans are given.

17507 (DOE/METC—87/6079-Vol.1, pp 215-219) **Coal slurry letdown device.** Marner, W.J.; Collins, E.R.; Rohatgi, N.K. (California Institute of Technology, Pasadena). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

A problem common to most coal gasification and liquefaction processes is the lack of reliable, long-life pressure letdown systems. The standard approach to pressure letdown is to throttle the flow by reducing the flow area in a throated control valve. Unfortunately, high velocities in the valve throat combine with the abrasive solids content of typical coal-derived slurries resulting in excessive valve wear, lack of controllability, and short lifetimes. An alternative approach, developed at the Jet Propulsion Laboratory, California Institute of Technology, is to reduce the throat velocities by using the concept of the porous plug. In this technique the pressure is reduced by means of a throttling process through a series of successive stages. Each stage consists of a perforated plate and a plenum chamber. The number and size of the orifice holes are chosen to be large enough to pass entrained particles while maintaining low velocities through the orifices in the latter stages to accommodate volumetric flow rate increases resulting from liquid flashing to vapor as the pressure is reduced. The four major tasks in this effort include: (a) development and testing of the PLS, (b) experimental erosion studies and analysis, (c) control of the PLS, and (d) development of an ash letdown unit based on the PLS technology. In this paper attention is focused on Items (c) and (d) since these tasks have received most of the attention in the current fiscal year.

17508 (DOE/METC—87/6079-Vol.1, pp 220-224) **Development of iron aluminides for coal gasification systems.** McKamey, C.G.; Liu, C.T. (Oak Ridge National Lab., TN). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

Currently, heat-resistant alloys are either nickel-based or high-nickel-content steels containing a delicate balance of one or more of the strategic elements such as chromium, cobalt, and tungsten to produce the desired properties. The alloys under investigation in this study (iron aluminides) do not contain significant amounts of strategic elements, and they also have properties that make them attractive for fossil energy applications. Because of their ability to form a protective aluminum oxide film at very low oxygen partial pressures, iron aluminides near the Fe_3Al composition exhibit excellent corrosion resistance (including resistance to sulfidation) at high-temperatures in such environments. Other advantages are high strength at room temperature, lower density, and lower cost. Although the usefulness of the binary alloys is limited by low room-temperature ductility (1-2%) and poor hot strength above 550°C, studies of several advanced (with minor alloy additions) iron-aluminum alloys based on the Fe_3Al composition indicate dramatic improvements in properties. This report describes recent progress in characterizing the effects of additions of other elements (< 10 at. %) on the metallurgical and mechanical properties of their selected base alloy, Fe-28 at. % Al.

17509 (DOE/METC—87/6079-Vol.1, pp 225-229) **Protective coatings and claddings: application/evaluation.** Ellingson, W.A.; Gopalsami, N.; Wang, D.Y. (Argonne National Lab., IL). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The previous work on this program included microstructural examination of as-received coated materials and the investigation of the corrosion behavior of these materials in two different gaseous environments under both isothermal and thermal-cycling conditions. One of the conclusions/recommendations arising from this work was that methods must be developed to characterize coating defects and to establish a relationship between the nature of the defects (e.g., type, size, shape and orientation) and the observed corrosion behavior. Consequently, efforts in this fiscal year were directed toward development of nondestructive evaluation techniques for coatings. Techniques that hold promise for the present application are reviewed, followed by a discussion of preliminary experimental results on a selected techniques. The techniques discussed are: thermal-wave imaging, scanning acoustic microscopy, and backscattered surface waves. 6 references.

17510 (DOE/METC—87/6079-Vol.1, pp 230-240) **Ash and slag characterization.** Falcone, S. (Univ. of North Dakota, Grand Forks). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objective of this ongoing research project is the development of a unified picture of chemical and mineralogical changes occurring during ashing and slagging of low- and high-rank coals and the associated changes in certain slag physical properties during gasification. Specific tasks to be addressed include: (1) the mechanisms operating on the inorganic portion of the coal resulting in mineral transformations affecting ash and slag formation, (2) the nature of the volatile inorganic species released from the coal, and (3) the formation of slag and its composition and physical behavior (i.e. viscosity and surface tension) as related to slag flow and ash agglomeration. The project is described and results are discussed on the following tasks: viscosity data base; evaluation of predictive viscosity equations; viscosity study of commercially-generated agglomerated vs. non-agglomerated ash samples; and effect of atmosphere and composition on viscosity and surface tension, and sintering. 6 references, 6 figures.

17511 (DOE/METC—87/6079-Vol.1, pp 241-250) **Experimental and theoretical investigation of the formation and growth of ash agglomerates.** Carty, R.H.; Rehmat, A. (Institute of Gas Technology, Chicago, IL). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

In the ash chemistry studies completed in 1986, the research program addressed the key issues of ash particle contact, conditions and rates of reaction of mineral matter, and agglomeration conditions in fluidized-bed gasification. The specific objectives of the investigated were to determine: the effect of coal mineral matter variation on the behavior of ash and to correlate this behavior with a

detailed analysis of the mineral matter present in the coal; the reaction rates of individual clays and silica with the pyrite and carbonates of coal; and the feasibility of employing the dielectrophoretic manipulation technique (DEM) to identify the conditions under which colliding ash particles coalesce, shatter, or deposit. Five eastern and two western coals were tested under this project. Coals were sought whose ash composition would reflect the full range of the most important variable for agglomeration, the average concentration of pyrite relative to the siliceous minerals.

17512 (DOE/METC—87/6079-Vol.1, pp 270-278) **Status report on KILnGAS commercial module.** Enright, F.J.; Garside, P.G.; Johnson, B.T. (Allis-Chalmers Coal Gas Corp., Milwaukee, WI). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

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The KILnGAS process uses a ported and pressurized rotary kiln to produce fuel gas from coal, suitable for use in combined-cycle power generation plants. Demonstration and testing is being performed in a 600 ton-per-day plant (KILnGAS Commercial Module) located on the site of the Wood River Station of Illinois Power Company in East Alton, Illinois. The overall RAM (Reliability, Availability, Maintainability) program objective is to operate the KILnGAS Commercial Module to obtain sufficient data and experience to verify process performance expectations for to provide a basis for commercial offering. Specific objectives for RAM phase IIA which is the subject of this paper were as follows: improve plant availability; operate at 30% carbon in gasifier ash while in the biflow mode of operation; determine plant carbon losses; operate at 75% of design production rate; and determine constraints that limit gas production rates. 6 references, 6 figures, 2 tables.

17513 (DOE/METC—87/6079-Vol.1, pp 321-330) **Zirconia cell oxygen source.** Suitor, J.W.; Marner, W.J.; Schroeder, J.E. (California Institute of Technology, Pasadena). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The project sponsored by DOE is a five year effort leading to the operation of a 100 liter/min oxygen production unit. During this time an industrial partner will be located to whom the technology will be transferred. The oxygen production unit will consist of a zirconia module for oxygen separation and the ancillary equipment arranged as an oxygen production plant. The zirconia module operates on the principle of electrodialysis. The paper describes the zirconia oxygen separation and the oxygen plant concept, then discusses results from the following subtasks: cell design and testing, module design, materials fabrication, and design of 100 liter/min unit.

17514 (DOE/METC—87/6079-Vol.1, pp 331-340) **Materials development for JPL oxygen plant.** Poeppel, R.B.; Easler, T.E. (Argonne National Lab., IL). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The purpose of this research program is to establish the durability of thin electrolyte layers so that minimum component thicknesses may be used in a solid oxide oxygen pump, as the means of reducing internal power losses, while still maintaining the required mechanical integrity of the structure. Previous and current work has proven the feasibility of fabricating thin-section ceramic components by techniques such as tape casting. Proof-of-concept work has also been carried out illustrating that thin ceramic sections can be successfully bonded together as anode/electrolyte/cathode units for fuel cells. Although this technology has been developing rapidly, there is a lack of information on the ability of these structures to survive the stress and/or strains imposed by the assembly configuration and operating conditions. Several potential failure modes have been identified. These are (1) thermal gradients induced by rapid cooling, (2) thermal gradients induced by nonuniform power dissipation, e.g., high-current hot spots, (3) interfacial stresses resulting from thermal expansion mismatch, (4) tensile and bending stresses introduced by clamping, (5) biaxial bending caused by unbalanced gas pressures across a thin section, (6) local stresses induced by corrosion or chemical reaction between components. The purpose of this program is to assess the importance of each of these failure modes through phenomenological tests, each of which approximates as nearly as practical the conditions leading to one specific failure type.

17515 (DOE/METC—87/6079-Vol.2, pp 363-371) **Catalytic gasification fundamentals.** Heinemann, H.; Somorjai, G.A. (Lawrence Berkeley Lab., CA). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2). Contract AC03-76SF00098.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The major purpose of this project is to find catalysts which will permit steam gasification of carbonaceous material at reasonable rates and at lower temperatures than currently practiced. An understanding of the catalytic mechanism is necessary to provide leads towards this aim. Surface characterization of intermediates in the catalytic steam gasification of chars have been completed. Mechanisms of gasification with a potassium/nickel oxide catalyst have been illustrated by electron microscopy and kinetics derived from movies taken during the gasification in a CAEM chamber of the electron microscope compared with flow reactor kinetics. Comparisons of chars with graphite have been completed and allow deductions to be made from graphite to char. Ratios of carbon monoxide and carbon dioxide produced along with hydrogen have been determined as a function of operating conditions as well as catalyst and ash composition of the chars. Results are discussed. 3 references, 5 figures, 2 tables.

17516 (DOE/METC—87/6079-Vol.2, pp 372-381) **Production of hydrogen from low-rank coals.** Sears, R.E.; Timpe, R.C. (Univ. of North Dakota, Grand Forks). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The research program includes the design, construction, and testing of a 6-inch diameter fluid-bed system and determination of the optimum operating conditions for producing low-cost hydrogen. Data collected from this process development work will be used to generate an economic assessment of the process. In addition, gas and waste water treatment, end-use applications, and the integration of thermochemical cycles for enhancement of hydrogen yield will be evaluated as part of a systems approach study to be performed in conjunction with the process economics study. A companion TGA study will determine reactivities of a suite of selected low-rank coals computed on both a weight basis and an active site basis. Instrumental analysis to be performed on each coal char and ash that are derived from reactivity studies will include solid ^{13}C Nuclear Magnetic Resonance (NMR) spectroscopy, X-ray diffraction, X-ray fluorescence, and Electron Spectroscopy for Chemical Analysis (ESCA) and Scanning Electron Microscopy (SEM) surface analysis. Coal reactivity will be correlated with identified coal properties to help elucidate the mechanism for catalytic steam gasification to produce hydrogen. Preliminary results from the coal properties and reactivity study are given. The process development unit is in its initial shakedown testing at present. 5 references, 3 figures, 3 tables.

17517 (DOE/METC—87/6079-Vol.2, pp 382-392) **Biological degradation of low-rank coal.** Jones, W.J.; Chian, E.S.K. (Georgia Institute of Technology, Atlanta). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The primary goal of this contract is to assess the anaerobic bioconversion of low-rank coal to fuel products such as methane. Selected model compounds, representative of constituents of low-rank coal, were tested for anaerobic bioconversion under methanogenic and nitrate-reducing conditions. In addition, studies were performed to evaluate the toxicity (inhibition) of model compounds on growth and activity of diverse microorganisms. The results of these

studies are discussed and demonstrate the potential for bioconversion of low-rank coals and related aromatic organic compounds using anaerobic bacterial consortia. Model compounds included phenol, 2-naphthol, 1-naphthoic acid, and 9-phenanthrol. 11 references, 11 tables.

17518 (DOE/METC—87/6079-Vol.2, pp 413-421) **Injection of densely loaded flows into entrained-flow gasifiers.** Kollrack, R.; Morrison, C.; Bragg, W.N.; Edelman, R. (Science Applications International Corp., Chatsworth, CA). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2). Contract AC21-85MC22064.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The main objective of this work is to develop a broad understanding of the relevant mixing phenomena for densely laden particle-gas streams injected into quiescent air or moving air streams. A practical application of the results will be the development of improved injection and mixing configurations for entrained-flow coal gasifiers. As a first step, injection of non-reacting particle/air streams into quiescent air is considered. The specific objective is the development of a model and computer code capable of describing multi-phase laminar and turbulent jet flows, turbulent pipe flows with, and without, swirl and turbulent flows with sudden expansion. Emphasis is directed toward modeling dense loading conditions. An experimental test facility is constructed to allow velocity and concentration measurement on well defined dense multiphase flows. Well defined implies a known particle distribution, particle size and shape, as well as (perfectly) elastic collision between particles. The purpose of the experimental data is to help validate and refine the current model, as well as to be directly applicable to entrained-flow gasifier designs. The validated/refined multi-phase flow model will be applied in parametric-type studies to correlate various inlet conditions with resultant mixing rates for different injector configurations.

17519 (DOE/METC—87/6079-Vol.2, pp 422-430) **Attrition and entrainment studies related to fluidized-bed coal gasifiers.** Knowlton, T. (Institute of Gas Technology, Chicago, IL). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2). Contract AC21-85MC22061.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The effects of gas velocity, system temperature and chemical reaction on the attrition rate of bituminous and lignite coal chars in a fluidized bed was determined. The investigation was conducted in a 6-inch-diameter ambient-pressure fluidization unit. The effect of fluidizing-gas velocity on the attrition rate of two chars at ambient temperature was first determined. Attrition tests were then conducted in the fluidized bed at three temperatures over the temperature range of 70° to 1800°F. Finally, tests were conducted on the same chars with chemical reaction occurring in the fluidized bed. The results from these three sets of tests were then compared to determine the relative importance of mechanical, thermal, and chemical reaction effects on the generation of coal fines in fluidized beds. Tests were also conducted in an 8-inch-diameter, high-pressure fluidized-bed unit to determine the effect of gas density on the attrition rate of lignite and bituminous coal chars. The tests were conducted over the pressure range of 25 to 350 psig. The effects of gas density and gas viscosity on the entrainment rate and the transport disengaging height of bituminous and lignite coal chars in a fluidized bed are being determined. The tests are being conducted in the 8-inch-diameter Advanced Multipurpose Research Reactor over a pressure range of 25 to 350 psia and a temperature range of ambient up to 1600°F. Results to date are discussed.

17520 (DOE/METC—87/6079-Vol.2, pp 442-450) **Low temperature, sulfur tolerant, homogeneous catalysts for the water-gas shift reaction.** Laine, R.M.; Wood, B.J.; Krishnan, G.N.; McCarty, J.G.; Schwaar, R.H. (SRI International, Menlo Park, CA). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2). Contract AC21-85MC22065.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objective of this project is to identify, prepare, test, characterize, and evaluate a practical, homogeneous catalyst for the production of hydrogen from coal gas by the water-gas shift reaction. The research effort is divided into five tasks: comprehensive review of the literature and selection of ten candidate catalysts; development of a catalyst evaluation test plan; testing of candidates to identify one superior catalyst and evaluation of the reaction kinetics of this catalyst; development of a mathematical model that uses the measured rate data to describe the catalytic process; and preparation of a techno-economic evaluation of the process. The experimental testing program, using as feed a simulated Texaco oxygen-blown gasifier coal gas in a batch test arrangement, is currently in progress. To date, screening tests have been performed using carbonyl-complex catalysts based on Cr, Fe, Mo, Rh, Ru, and W respectively, in addition to mixed Fe and Ru complexes. Preliminary results are described from these tests as well as from the techno-economic analysis of a 1000-ton/day hydrogen plant.

17521 (DOE/METC—87/6079-Vol.2, pp 530-536) **Biological gasification.** Isbister, J.D. (Atlantic Research Corp., Alexandria, VA). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The program has three specific objectives: to demonstrate on a laboratory scale the microbial conversion of three coals (North Dakota Lignite, Wyodak subbituminous and Ohio bituminous) to methane; to demonstrate the microbial conversion of coal to methane in a continuous bench-scale process; and to develop design criteria for pilot-scale and economic analysis for full-scale microbial coal to methane conversion units. This research project has as its ultimate goal the development of an efficient, economical microbial process for conversion of undesirable coals to a clean fuel, methane. Two approaches to conversion of three coals of varying rank into liquid products will be evaluated. One approach will use chemical/thermal softening techniques to break, the cross linked coal matrix into high molecular weight liquids. A second approach will use an unique consortium of fungi and bacteria isolated by Atlantic Research to break down the coal macromolecular structure with resulting liquid products. The aqueous soluble products from chemical/thermal softening and from the microbial solubilization will be characterized and comparisons will be made with respect to molecular weight of products and extent of coal depolymerization by each treatment. The test plan is described and preliminary results only are given.

17522 (DOE/METC—87/6079-Vol.2, pp 542-547) **Expansion of high-temperature, high-pressure data set for coal gasification.** Jenkins, R.G.; Scaroni, A.W. (Pennsylvania State Univ., University Park). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2). Contract AC21-84MC21376.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The primary objective of this project is to provide a complementary study to those being undertaken by METC and Advanced Fuels Research Corp. in the area of high-temperature, high pressure coal devolatilization/gasification. This study will extend the data base into shorter residence times (< 1 s) to investigate the effect of pressure on the initial stage of coal devolatilization. The effects of rank, pretreatment and gaseous atmosphere on coal devolatilization under pressure will also be investigated. A set of weight loss and product distribution data, which directly overlaps those generated by METC and AFR has been generated for residence times from 1-3 seconds, pressures between 100-900 psig, and temperatures up to 1100°C. Relevant chemical and physical analyses of the devolatilization products; char, condensibles and gases, have been performed. A meaningful comparison of results generated in the extended and supporting studies, which have no direct overlap, can be made based on this set of data. A comprehensive global kinetic model for devolatilization of the coals is being produced. Results to date are given and discussed. 6 references, 9 figures.

17523 (DOE/METC—87/6079-Vol.2, pp 548-552) **Expansion of high-temperature, high-pressure data set for coal gasification.** Serio, M.A.; Hamblen, D.G. (Advanced Fuel Research, Inc., East Hartford, CT). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The program has three major objectives: (1) determination of chemical kinetic rates for pyrolysis and CO_2 gasification; (2) investigation of the relationship between char reactivity and char formation conditions, particularly with regard to heating rate and pressure; and (3) investigation of the effect of high temperature and high pressure on pyrolysis and gasification reactions. The effects of particle size, heating rate, and reactive gas were studied along with temperature and pressure. The plan also included supporting studies to provide baseline (1 atm. pressure) data on the thermal and optical properties, pyrolysis kinetics, and char reactivity for Montana Rosebud subbituminous coal. Selected studies were done on a Kentucky No.8 bituminous coal. Four different reactor systems are being used: (1) high pressure entrained flow reactor, (2) atmospheric pressure entrained flow reactor, (3) heated tube reactor, (4) thermogravimetric analyzer/evolved gas analyzer. The latter three facilities include in-situ FT-IR diagnostics. The high pressure reactor system has been modified to allow experiments up to 500 psig. Results on the following are discussed: pyrolysis kinetics and product yield at one atm. pressure and at high pressure; char reactivity studies; and effect of pressure on tar yields and molecular weight distributions. 10 references.

17524 (DOE/METC—87/6079-Vol.2, pp 553-566) **Advanced gasification entrained reactor.** Bissett, L.A. Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

Devolatilization and associated phenomena occur in nearly all coal conversion processes, but are particularly important in entrained gasification due to the small particle sizes, high temperatures, and short residence times involved. The objectives of this project are to determine the effects of coal gasification environment on product yields over broad range of reaction conditions and advance the understanding, development, and modeling of gasification technology. Instead of having coal type as a variable, a comprehensive test program was pursued on one coal (Montana Rosebud subbituminous) employing a statistical experimental design. This has enabled the use of regression modeling and statistical analyses of the test data. Experimental trends identified by this approach are being compared to predictions from the PCGC-2 computer code and will hopefully lead to code improvements. The code is also being used to estimate experimental gas and particle residence times. Results are given and discussed. Future plans call for testing of a bituminous coal.

17525 (DOE/METC—87/6079-Vol.2, pp 591-595) **Mechanistic study of the energetic heterogeneity of coal chars.** Calo, J.M. (Brown Univ., Providence, RI). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2). Contract AC21-87MC23284.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objective of this contract is to examine the relationships between the energetic heterogeneity of coal char surfaces and gasification reactivity. The project involves both experimental and analytical components. The basic experimental approach involves the application/adaptation of temperature-programmed desorption/mass spectrometry (TPD/MS) of surface species formed upon exposure of well-characterized coal char samples to adsorbent gases. In the current project, char surface heterogeneity will be determined primarily using oxygen chemisorption, followed by TPD. A Heterogeneous Surface Model has been developed for CO_2 gasification, based upon the oxygen-exchange mechanism and an assumed linear energetic distribution of active sites. This is discussed. Experimental work is still in its initial stages. 5 references.

17526 (DOE/METC—87/6079-Vol.2, pp 596-609) **Fundamental fluidization research program at Morgantown Energy Technology Center.** Mei, J.S.; Keech, T.W.; O'Brien, T.J. Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

METC is conducting extensive fluidization research in support of various Fossil Energy Programs. Despite the widespread application of fluidized-bed reactors, the basic understanding of the fluidization phenomena is imprecise and based on a guess and try approach. The METC fluidization research program was initiated in early 1986 with the objectives of providing in-depth, validated data and developing a comprehensive predictive capability. These will increase the understanding of fluidization processes and provide a sound basis for the design of fluidized-bed reactors for fossil energy applications. The fluidization research program is focused on the specific fluidized-bed technology needs identified in the Advanced Coal Technology Programs for the three major technology areas, coal combustion, coal gasification, and oil shale retorting. The initial program implementation will focus on the test facility development, novel instrumentation development, along with modification of existing models. The salient design features of the test facilities, which include a 1-foot diameter atmospheric fluidized-bed cold model and a 2-foot diameter pressurized fluidized-bed warm model, are described. The initial experiments to be conducted in the 1-foot unit to characterize the flow regimes and their transitions are discussed. Several novel instrumentation developments, which will provide better techniques to measure local bed voidage and solid circulation patterns, are presented. Extensions of comprehensive mechanistic fluidized-bed code are also described. These include implementation of an improved gas/solid drag law, a realistic granular phase stress tensor, and the ability to describe a particle size distribution. This code has now been used to simulate many fluidization phenomena, most recently, particle segregation.

17527 (DOE/METC—87/6079-Vol.2, pp 624-628) **Modeling hydrodynamic mixing in process design and development of fluidized bed gasifiers.** Blake, T.R. (Univ. of Massachusetts, Amherst). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2). Contract AC21-85MC22062.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

In this project, models for hydrodynamic mixing in fluidized beds are to be used in a representative process design and development scenario for the KRW gasifier. The particular emphasis in this study is upon the use of two modeling approaches: the dimensional analysis and scaling of fluidization data, and the finite difference hydrodynamic model CHEMFLUB. Predictions of hydrodynamic mixing in the KRW reactor are made. Further, the relative value and practicality of the two different models for predicting hydrodynamic mixing is to be assessed. The status of the project is described. 10 references.

17528 (DOE/METC—87/6079-Vol.2, pp 629-641) **Novel concepts of system assessment in coal gasification.** Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objective of this task is to assess the impact of the end use and total system design on the economically desirable operating conditions and design properties of gasifier. It is also intended to investigate novel system configurations that will improve the performance and cost of the total system, and inquire what gasifier properties lead to better overall system properties. Two related problem areas were chosen for this study, which are: assessment of gasifier requirements for generation of electricity from coal in combined cycle power plants that have very low emissions and acceptable disposable solids, high thermal efficiency, lower investment costs and suitability for modular construction, and the ability to produce liquid hydrocarbons by mild gasification; and study the potential of a slagging and a fluid bed gasifier for hydrogen production with the coproduction of methane and mild gasification products and assess the impact of novel separation processes on the

overall cost and performance of such a system as well as on conventional hydrogen plants from coal. Achievements to date are discussed including effects of changes in operating parameters and the effect of steam balance. 6 references.

17529 (DOE/METC—87/6079-Vol.2, pp 668-678) **KRW process development coal gasification/hot gas cleanup.** Smith, K.J.; Haldipur, G.B.; Lucas, J.L. (KRW Energy System, Inc., Madison PA). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2). Contract AC21-84MC21063.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The goal of the technology development at KRW is to provide the electric utility industry with an advanced technology for integrated combined cycle power plants that has a low installed cost, a competitive heat rate and cost of electricity, and superior environmental acceptability and can be added in manageable increments. The specific objectives of the Waltz Mill Process Development Unit (PDU) operation are: (1) to demonstrate operability of two complementary hot gas sulfur removal systems: gasifier in-bed desulfurization with a once-through calcium based sorbent and external bed desulfurization utilizing a regenerable zinc ferrite sorbent, (2) to demonstrate hot particulate collection/removal technology, and (3) to characterize levels of particulate, ammonia, alkali, and sulfur emissions from coal gasification as necessary to meet the requirements for power generation and environmental standards. Results are discussed from the testing of the external desulfurization including zinc ferrite regeneration performance. The consumption of simulated recycle SO_2 by the in-bed gasifier/desulfurizer is also discussed. 5 references, 6 figures, 4 tables.

17530 (DOE/PC/80507—T9) **Catalytic coal gasification: Identification of active sites: Reporting period, October 15, 1987-January 14, 1988.** Falconer, J.L.; Lauderback, L.L. (Colorado Univ., Boulder (USA)). 15 Jan 1988. Contract FG22-85PC80507. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88004829/JAW.

This research uses transient isotope tracing, at steady-state reaction conditions, in combination with surface analysis techniques (secondary ion mass spectrometry (SIMS) and x-ray photoelectron spectroscopy (XPS)). Carbon dioxide gasification of carbon blacks and coal char will be used initially, since this appears to be rate-determining during steam gasification; steam gasification will be used in later experiments. In a typical isotope tracing experiment, $^{12}CO_2$ flow over a carbon-catalyst mixture will be quickly replaced by $^{13}CO_2$ at the same pressure and flow rate. The changes in the concentrations of ^{12}CO and ^{13}CO products, and in the $^{12}CO_2$ and $^{13}CO_2$ concentrations, as a function of time, will be measured with a computer-controlled mass spectrometer. The use of isotope transients allows the concentration of active catalytic sites to be measured directly at reaction conditions and it allows the rate constant to be measured. Isotope tracing will be carried out as a function of reaction temperature, catalyst loading, catalyst type and carbon conversion. Surface analysis techniques will be used to determine the active forms of the catalysts. Model studies of catalyst-carbon interactions will also be carried out with SIMS in order to determine the form of surface species. The combination of isotope tracing and surface analysis will elucidate the details of the reaction mechanism. This insight into the mechanism of coal gasification will help in improving process kinetics for gasification.

17531 (DOE/PC/90514—T5) **Anaerobic fluid-bed treatment of coal conversion wastewater: Fifth quarterly technical progress report for the period August 15 to November 15, 1987.** Suidan, M.T.; Pfeffer, J.T.; Nakhala, G.F.; Traegner, U.K. (Illinois Univ., Urbana (USA). Dept. of Civil Engineering). 1987. Contract FG22-86PC90514. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005164/JAW.

Anaerobic fluidized-bed granular activated carbon (GAC) reactors have been proven successful for the treatment of biologically inhibiting wastewaters such as coal conversion wastewaters. However, in treating such wastewaters which contain compounds that not only resist biodegradation, BUT ALSO INHIBIT THE DEGRADATION OF OTHER COMPOUNDS, adsorption on granular activated carbon represents a viable strategy for the removal of these inhibitory compounds. Since the adsorptive capacity of the reactor media is limited, partial replacement of the carbon bed is then necessary to maintain the concentration of inhibitory compounds below threshold levels. The hydraulic detention time and the associated carbon inventory maintenance represent the single most important capital cost parameter. The objectives of this research are to determine, using experimental and modeling strategies, the effects of hydraulic detention time and the schedule of GAC replacement on the performance of these fluidized bed GAC anaerobic reactors. This objective is realized by the following activities: operation of two expanded-bed GAC anaerobic reactors at empty-bed hydraulic detention times of 1.0 and 0.5 days. These reactors will be referred to as reactors 1 and 2, respectively. The wastewater fed to the two reactors includes phenol, acetic acid and o-cresol as model compounds of a real coal conversion wastewater. Development of a mathematical model of the expanded-bed GAC anaerobic reactor incorporating the various interactions that occur in this process such as biodegradation, adsorption on GAC, and the regular replacement of reactor GAC with virgin media. 1 ref., 1 fig., 6 tabs.

17532 (DOE/PC/90529—5) **Micropore diffusion in coal chars under reactive conditions: Quarterly technical progress report, 15 October 1987-15 December 1987.** Perkins, M.T.; Calo, J.M.; Lilly, W.D. (Brown Univ., Providence, RI (USA). Div. of Engineering). 1987. Contract FG22-86PC90529. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004950/JAW.

Work during the reporting period was focused primarily on obtaining diffusion data for a 5A zeolite. A zeolite, rather than a char, was selected for this preliminary work in order to establish the procedural experimental technique with a material that is known to be exhibit microporosity very similar to that of many coals, and for which there is a voluminous literature. Also, the zeolite is not sensitive to air at elevated temperatures, which is useful for troubleshooting the system with respect to leaks. This work resulted in our first direct measurements of micropore diffusion time constants, which seem to agree reasonably well with available literature values. The results of these tests are summarized in this report. 14 refs., 5 figs., 1 tab.

17533 (EPRI-AP—5343-SR, pp 11.1-11.29) **Commissioning of the Prenflo test unit.** Pohl, H.C. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920087/JAW. (CONF-8610351—).

From 6. annual EPRI contractors' conference on coal gasification; Palo Alto, CA, USA (15 Oct 1986).

Operation of the Prenflo coal gasification test unit in West Germany was started on August 12, 1986. This paper lists the characteristics of the Prenflo process, a modification of the Shell-Koppers gasification process, and the main objectives of the development program, and then describes construction of the 48 tpd unit, the burner test rig, the Prenflo 48 tpd test program, and operational experience and results to date. 25 figures.

17534 (EPRI-AP—5343-SR, pp 12.1-12.4) **Coal gasification in a liquid iron bath by the MIP-Process.** Henrich, G.; Pook, H.; Waldhecker, H.D. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920087/JAW. (CONF-8610351—).

From 6. annual EPRI contractors' conference on coal gasification; Palo Alto, CA, USA (15 Oct 1986).

KHD Humboldt Wedag AG and Sumitomo Metal Industries Ltd. are jointly developing the MIP (Molten Iron Puregas)-Process for the gasification of coal with oxygen in a liquid iron bath by bottom- and top-blowing. Either method is tested in a pilot plant having a coal throughput rate of 10 t/h. The advantages of the MIP-Process are the very pure gas quality (70% CO, 30% H_2) and a very low sulfur content. The pilot plant and the process are described, and test results and applicability of the coal gas are discussed. 3 figures.

17535 (EPRI-AP—5343-SR, pp 13.1-13.49) **Experience with supplying oxygen to an IGCC power plant and evaluation of alternative supply arrangements for future coal gasification facilities.** Petras, R.A.; Mostello, R.A. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920087/JAW. (CONF-8610351—).

From 6. annual EPRI contractors' conference on coal gasification; Palo Alto, CA, USA (15 Oct 1986).

BOC Cryoplants, the engineering and construction arm of Airco Industrial Gases, has installed a 1000 T/D oxygen plant to supply the Cool Water Coal Gasification Program in Daggett, California. This is the first application of a dedicated oxygen plant to a commercial size integrated gasification combined cycle (IGCC) power plant. Oxygen at 99.5% purity is supplied by pipeline to the program while liquid argon is withdrawn for commercial sale by Airco. Oxygen plant power consumption has been demonstrated to be lower than guaranteed while design rates of oxygen production were easily achieved. Plant reliability has exceeded 98% during the first two years of supply. A test program to identify the load following characteristics of the oxygen plant was sponsored by the Cool Water Program and Airco Industrial Gases. The oxygen plant was able to automatically follow an oxygen demand signal transmitted by the Cool Water Program at rates of up to 8% per minute. Guidelines for establishing design ambient temperature conditions to optimize plant rangeability for future load following applications are provided. Argon production as it pertains to power plant economics was reexamined based on the Cool Water experience. Recent technological innovation to improve 95% purity oxygen plant performance as well as the impact of large quantities of argon on the marketplace were addressed. The argon producing plant was confirmed as supplying the lowest cost oxygen to the user. 23 figures, 1 table.

17536 (EPRI-AP—5343-SR, pp 14.1-14.19) **Simulator for gasification combined cycle plants: base case model development and testing.** Rovnak, J.A.; Schmidt, E.J.; Dixon, R.; McMorran, P. (Stone & Webster Engineering Corp., Boston, MA). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920087/JAW. (CONF-8610351—).

From 6. annual EPRI contractors' conference on coal gasification; Palo Alto, CA, USA (15 Oct 1986).

This paper addresses intermediate results from the Electric Power Research Institute project for dynamic simulation and analysis of Coal Gasification Combined Cycle (GCC) plants. With the introduction of commercial chemical process oriented technology into the utility industry, there is a need for better computer based project design tools for use from conceptual engineering through commercial operation. An objective is unified computer programs for use in process design, control system design, operation planning, operator guidance, and for training simulators. The rapid advance in computer hardware and support software is important since it will be possible to use this set of programs on a small but powerful, low-cost desk top computer. This design tool will lead to better conceptual alternatives, speed the design process, reduce errors, help prepare operating procedures, diagnose faulty equipment, improve performance, and assist in training operators and engineers. The GCC simulator is outlined in the paper together with sample output and results to date. Included is a review of initial work in which the generic engineering simulation code is down-loaded onto a minicomputer based basic principles trainer. A special exercise demonstrated the unique approach in which engineering analysis code is also used for training simulation. Feedback from utility participants is also presented. 9 references, 13 figures, 2 tables.

17537 (EPRI-AP—5343-SR, pp 1.1-1.9) **Coal gasification: from pilot plant to utility plans.** Womeldorff, P.J. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920087/JAW. (CONF-8610351—).

From 6. annual EPRI contractors' conference on coal gasification; Palo Alto, CA, USA (15 Oct 1986).

In ten years, Integrated Gasification-Combined Cycle (IGCC) has progressed from the research laboratory to become a demonstrated technology. The utility planner is now looking at a variety of technologies for favorable economic and environmental performance and the prospect of phased construction. Expansion plans which target IGCC for new capacity are now emerging. 10 references, 2 figures.

17538 (EPRI-AP—5343-SR, pp 2.1-2.16) **IGCC: the decisions are as complex as the technology.** Adjemian, K.; Smith, W.H.; Waters, S.S. (Florida Power & Light Co., Miami). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920087/JAW. (CONF-8610351—).

From 6. annual EPRI contractors' conference on coal gasification; Palo Alto, CA, USA (15 Oct 1986).

The development of Integrated Coal Gasification Combined Cycle (IGCC) technology appears to offer a new level of flexibility in long range planning, having the desired characteristics of multiple fuel capability and reduced committed capital investment via modularity and phased construction. These characteristics have led Florida Power and Light Company (FPL) to seriously examine IGCC power plants as a capacity option to meet future needs. This paper describes the results of a comprehensive planning study which evaluated the IGCC option versus established technologies such as pulverized coal, combustion turbines and combined cycle units. The results of the study indicate that the combined cycle option is favored over the coal technologies. Additionally, in economic scenarios where fuel prices are escalating rapidly, the economics of phased IGCC units are competitive with those of pulverized coal. 14 figures, 4 tables.

17539 (EPRI-AP—5343-SR, pp 3.1-3.31) **Small bites avoid indigestion - a capacity planning strategy.** Crumley, T.E.; Lang, J.C.; Mormann, S.A. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920087/JAW. (CONF-8610351—).

From 6. annual EPRI contractors' conference on coal gasification; Palo Alto, CA, USA (15 Oct 1986).

During 1985, Baltimore Gas and Electric Company's generating planners took a long hard look at the future, out to the year 2014. The primary purpose of this undertaking was to examine how the tradeoff between large efficient base load units and smaller modular units that could be phased into service would impact the customers and shareholders. The entire analysis consisted of three steps. First, an optimal mix study was conducted to determine the percent of new capacity additions that should be combustion turbines (peaking capacity). Secondly, a series of expansion plans was developed encompassing various combinations of plants and technologies. And finally, the expansion plans were assessed in terms of economics and financial implications. These three studies are described. Various scenarios are evaluated for rate payer impact; shareholder return; financial risk; regulatory risk; technology risk; planning flexibility; operating flexibility; and environmental impact. The IGCC scenario received the highest ranking in four of the eight categories evaluated; and in two other categories it received the second highest score. 22 figures.

17540 (EPRI-AP—5343-SR, pp 4.1-4.37) **Evaluation of a coal gasification facility for the Devon repowering project.** Rorstrom, E.G. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920087/JAW. (CONF-8610351—).

From 6. annual EPRI contractors' conference on coal gasification; Palo Alto, CA, USA (15 Oct 1986).

The conceptual design of a coal gasification facility producing medium-Btu fuel gas from a Pittsburgh bituminous coal is described in this report. The gasification facility is sited at Connecticut Light and Power Company's Devon Generating Station, Milford, Connecticut. The facility design incorporates the proprietary Shell Coal Gasification Process. This process uses a pressurized, high temperature, entrained flow gasification reactor to perform the initial conversion of coal to gas. Dry pulverized coal, oxygen, and a small quantity of steam is fed into the process to produce a medium-Btu gas with a higher heating value of 301.0 Btu/SCF. The plant consumes 5688 tons of coal per day to produce 5083 MM Btu/Hr of medium Btu gas. The synthetic gas is supplied to a combined cycle plant adjacent to the proposed facility. Minimal integration of the gasification and combined cycle systems is included in the plant design. A description of the site and plant facilities including overall material and energy balances, block flow diagrams, and

site arrangement drawings are presented. A description of the major systems including an equipment summary are also provided. An overall capital cost estimate and project execution schedule were prepared. An economic analysis of the coal gasification plant facility prepared by Northeast Utilities Service Company is presented. This analysis compares the economics of the gasified coal combined cycle plant with two options, a pulverized coal steam plant and the repowered plant without the gasification process. 23 figures.

17541 (EPRI-AP—5343-SR, pp 5.1-5.13) **Cool Water: mid-term performance assessment.** Clark, W.N.; Shorter, V.R. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920087/JAW. (CONF-8610351—).

From 6. annual EPRI contractors' conference on coal gasification; Palo Alto, CA, USA (15 Oct 1986).

The Cool Water plant, now approximately halfway through its five-year commercial demonstration (6/84-6/89), has proven that integrated gasification combined-cycle (IGCC) technology can reliably produce economical electrical power while limiting emissions of SO_2, NO/sub x/ and particulates to a rate only one-tenth of the Federal New Source Performance Standards for coal-fired plants. The solid effluent streams at Cool Water include a slag that has been declared non-hazardous (which Cool Water plans to market as road-bed aggregate, etc.) and a 99.5% + pure elemental sulfur which has always been sold. Process water requirements are 40% less than those of a conventional coal-fired utility plant equipped with flue-gas desulfurization units for stack gas scrubbing thus reducing waste water treatment requirements. The IGCC technology employed at Cool Water has now been demonstrated to efficiently convert coal to electricity in an environmentally superior fashion. 8 references, 3 tables.

17542 (EPRI-AP—5343-SR, pp 6.1-6.24) **Status of the Shell coal gasification process.** Perry, R.T.; Nager, M. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920087/JAW. (CONF-8610351—).

From 6. annual EPRI contractors' conference on coal gasification; Palo Alto, CA, USA (15 Oct 1986).

Development of the Shell Coal Gasification Process, which was initiated in the early 1970's, will culminate with the construction and operation of a new demonstration unit. Construction of the new facility, SCGP-1, is almost complete. SCGP-1 has coal receiving and preparation facilities, a high pressure gasifier with high temperature energy recovery, solids removal, and gas and water treating to provide clean medium-BTU gas and high-valued steam. SCGP-1 will start up on an Illinois high-sulfur bituminous coal. However, it is designed to run a wide range of feeds ranging from bituminous to wet, high-ash lignites. Feed rates will range from 250-400 tons/day as-received, depending on the properties of the coal. SCGP-1 will demonstrate improved mechanical and process configurations resulting from previous developmental programs. The knowledge SCGP-1 will provide will allow a very efficient route to the commercialization of the Shell Coal Gasification Process. 16 figures.

17543 (EPRI-AP—5343-SR, pp 7.1-7.12) **Dow syngas project: project overview and status report.** Fisackerly, R.H.; Sundstrom, D.G. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920087/JAW. (CONF-8610351—).

From 6. annual EPRI contractors' conference on coal gasification; Palo Alto, CA, USA (15 Oct 1986).

In the early 1970's, as a result of increasing energy costs and supply uncertainties, Dow recognized the need to establish alternative sources of energy to natural gas. In accomplishing this objective, Dow sought ways to take advantage of the advancements in combustion turbine technology and the US' most abundant natural resource, coal. The coal gasification research and development effort that followed included construction of a 36 tpd Pilot Plant in 1979 and a 1600 tpd Proto Plant in 1982. The unique Dow Coal Gasification Process represents the results of Dow's research and development efforts. The 2400 tpd Dow Syngas Project is the first commercial scale demonstration of that technology. This paper describes the project, coal grinding and slurry preparation, gasification and high temperature heat recovery, gas cleanup and low temperature heat recovery, H_2S removal, sulfur recovery and incineration, combined cycle plant, oxygen plant, and commercial application. 6 figures.

17544 (EPRI-AP—5343-SR, pp 8.1-8.24) **Kilngas program status report.** Garside, P.G. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920087/JAW. (CONF-8610351—).

From 6. annual EPRI contractors' conference on coal gasification; Palo Alto, CA, USA (15 Oct 1986).

The Kilngas process provides a means of converting high-sulfur coal and other carbonaceous materials into an economical, environmentally-clean, low-Btu gaseous fuel suitable for use in power generation. Development of the process began at Allis-Chalmers in 1971 and, through successive development and evaluation programs, has culminated in a demonstration facility (Kilngas Commercial Module) located on the site of the Illinois Power Company Wood River Generating Station at East Alton, Illinois. Construction of the Kilngas Commercial Module (KCM), was completed in 1983. Operational testing was begun in mid-83, and initial demonstration of the technology, using Illinois No.6 coal, was completed in 1984. Currently, a multi-phased Reliability, Availability, Maintainability (RAM) program is being conducted at the KCM. This paper highlights the results obtained from the first phase of the RAM program. Significant accomplishments associated with carbon conversion and routine operation, and significant findings associated with capacity provide the substance of these results. 3 references, 7 figures, 2 tables.

17545 (EPRI-AP—5343-SR, pp 9.1-9.9) **British Gas/ Lurgi gasifier: progress at Westfield.** Lacey, J.A.; Thompson, B.H.; Scott, J.E.; Turna, O.; Vierrath, H. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920087/JAW. (CONF-8610351—).

From 6. annual EPRI contractors' conference on coal gasification; Palo Alto, CA, USA (15 Oct 1986).

British Gas has operated a commercial scale high pressure fixed bed slagging gasifier at its Westfield station since 1975. This 350 ton/day unit has gasified well in excess of 100,000 tons of coal with over 900 hours on line, demonstrating the high reliability of the gasifier for commercial operation. Westfield Brifish Gas is now operating a 550 ton/day gasifier which incorporates most of the features of future commercial installations. This prototype commercial size gasifier is being used to confirm the flexibility and reliability of the earlier unit and will further enhance confidence in this gasification system. In cooperation with Rolls Royce an SK30 gas turbine generating set has been installed, which can be fired with fuel gas from the gasifier, or natural gas to produce power for sale. This paper describes the 550 TPD gasifier, commissioning trials, handling trials on agglomerated fines, the status of the power generation plant, the test program for the 550 TPD gasifier, and discusses applications.

17546 (EPRI-AP—5343-SR, pp 10.1-10.26) **Rheinbraun High-Temperature Winkler (HTW) demonstration plant for synthesis gas production: construction and start-up.** Engelhard, J.; Femmer, U.; Adlhoch, W. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920087/JAW. (CONF-8610351—).

From 6. annual EPRI contractors' conference on coal gasification; Palo Alto, CA, USA (15 Oct 1986).

After Rhenish brown coal had been successfully gasified in the HTW pilot plant, planning started in 1980 regarding a demonstration plant for the production of synthesis gas for methanol. Construction of the plant was completed in late 1985, and it is currently in the start-up phase. The plant has a design throughput of 30.5 t/hr of dry brown coal, which is equivalent to a synthesis gas production of 37,000 m^3 (STP)/hr. A 20 km pipeline conveys the synthesis gas produced to the site of the Union Rheinische Braunkohlen Kraftstoff AG, a Rheinbraun subsidiary, where it is fed into an existing methanol synthesis plant which is to test the conversion from coal gas to methanol. This paper describes the plant site, process, and construction, and discusses the start-up and experience to date, including the problems which have been encountered. 9 figures.

17547 (EPRI-AP—5508) Once-through methanol project support study: Final report. Daniels, L.E.; Kelly, D.A. (Tennessee Valley Authority, Muscle Shoals, AL (USA)). Dec 1987. 99p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920127/JAW.

This report summarizes the results of a gas characterization study conducted at TVA's 200 tons of coal per day Ammonia From Coal facility under EPRI contract RP2563-3 (TV-50942A, subagreement No. 27). The main thrust of the study was to determine the levels of trace components that are potentially harmful to a methanol catalyst in unshifted synthesis gas from a partial-oxidation gasifier. The study also included an evaluation of the performance of gas cleanup equipment while using unshifted gas. Data were gathered during operation with three different coals: Utah, Illinois No. 6, and Pittsburgh No. 8. Additional data were gathered during an environmental characterization study using a western Maryland coal. 3 refs., 9 figs., 39 tabs.

17548 (EUR—11128) Synthesis gas production in the blast furnace: Feasibility study, Demonstration project: Final report. (Universite Libre de Bruxelles (Belgium). Centre de Recherches Industrielles). 1987. 159p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88900366/JAW.

This is the final report of a feasibility study carried out in the frameowrk of the European Commission Energy Demonstration Programme. The aim of the study was twofold: to determine whether the conversion of a blast-furnace into a gas generator is technically feasible, and to evaluate the approximate cost price of the synthesis gas produced. It has been shown that the existing technique of injecting coal at the level of the tuyeres is directly applicable to coal gasification in the blast-furnace. Several operating scenarios have been studied, particularly in the light of the need to maintain an efficient circulation of fluids in the blast-furnace. From the economic viewpoint, the principal advantage of the process is that the capital investment required to convert the blast furnace into a coal gasifier is relatively small compared to the cost of a conventional gas generator. The former has been estimates at around 20 millions ECU for a production capacity of 80,000 Nm^3 per hour ($CO + H_2$). If the estimated are confirmed by large-scale testing, the cost price of the gas will be 60% of the cost price, per gigajoule, of gas from normal coal gasification, 67% of the price of gas from the reforming of natural gas and 64% of the price of gas from liquid hydrocarbons. A large part of the study deals with the analysis of the potential end uses of the huge quantities of syngas that would have to be used should this technology be applied. 37 figs., 27 tabs.

17549 (LBL—23930) Fundamental studies of catalytic gasification: Annual report, October 1, 1986-September 30, 1987. Heinemann, H. (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 89p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88004901/JAW.

This program studies the basic chemistry of the reaction of carbonaceous materials with water in the presence of catalysts to produce hydrogen and/or synthesis gas. Relatively low temperatures are being used. The catalysts under investigation are compounds of potassium and a transition metal oxide. Major objectives are the extension of the work from chars to coke; the effect of H_2, CO and CO_2 partial pressure on the gaseous product distribution; and the inhibition of catalyst poisoning by ash components. 39 refs., 9 figs., 1 tab.

17550 (NP—8751955) Hydrocracking of vaporized pyrolysis products formed during coal gasification. Hedden, K.; Heinrich, K.H.; Morschett, F. (Karlsruhe Univ. (T.H.) (Germany, F.R.). DVGW-Forschungsstelle am Engler-Bunte Institut). Jun 1986. 176p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88751955/JAW.

The raw gases produced by coal gasification in moving-bed and fluidized-bed gasifiers contain pyrolysis products like tar vapors. Hydropyrolysis of such substances in the homogeneous gas phase needs temperatures above 800degC. The rate of reaction is increased by higher partial pressures of hydrogen. Investigations were performed to crack such substances catalytically at lower temperatures with acid, sulfur resistant catalysts. Laboratory tests at temperatures of about 600degC with a NiW/SiO/sub 2/Al/sub 2/O/sub 3/-catalyst were unsuccessful as the catalyst desactivated very quickly by coke formation. On the other hand, successful tests were performed to crack aromatic substances in a two-step process: In a first step the vapors are hydrogenated at a temperature of 350degC with a sulfur resistant NiMo/Al/sub 2/O/sub 3/-catalyst. In a second step light hydrocarbons are produced from the hydrogenated products of the first step in a hydrocracking reaction at temperatures of 350 to 400degC catalyzed by a NiW/SiO/sup 2/Al/sup 2/O/sup 3/-catalyst with high cracking activity. With 37 refs., 82 figs., 16 tabs.

17551 (NP—8770039, pp 63-80) Development of entrained bed type coal gasification power plant. Kitami, Tsuneo. 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

This article is a report on the result of a feasibility study on the technology for entrained flow coal gasification combined cycle power generation. NEDO made a feasibility study on technslogy for coal gasification combined cycle power generation throgh contract to CRIEPI (Central Researeh Institute of Electric Power Industry) and others for 3 yeras starting from 1983 and as a result designated the entrained bed type coal gasification combined cycle power generation as a selected subject to be studied, giving top priority to it. Furthermore, NEDO prepared a master plan of a pilot plant. The coal gasification combined cycle power generation is a system, high in thermal efficiency, utilizing heat in cascade in a method wherein fine coal is fed to a gasifier to generate combustible gas so as to make generation, while thermal energy of exhaust gas from a gas turbine is recovered and utilized as part of heat source for turning a steam turbine so as also to make genaration. Furtheremore, based on the results obtained from this feasibility study, Engineering Research Association for Integrated Coal Gasfication Combined Cycle power systems (IGC) which had been established in 1986 laid out a basic scheme to execute for seven years construction and operation test of a pilot plant of entrained bed type coal gasification with a capacity of 200 ton/day. The scheme aims at development and operation of a practical plant larger than 250 MW (in terms of a single equipment capacity) to be developed toward at the latest 2,000 A.D.

17552 (NP—8770044, pp 115-128) Research and development of coal gasification. Production of high BTU gas by 7,000 Nm^3/d plant. Ikeda, Hiroshi. (Electric Power Development Co. Ltd.). 21 Sep 1984. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

In Proceedings of parallel sessions for the 4th NEDO general assembly.

This study was performed as a research funded by NEDO.For the purpose of producing a clean gas to substitute LNG, LPG etc. from coal a research and development was carried out using a 7000 Nm^3/d plant. The research and development is based on an element research carried out by Hitachi Limited. And Electric Power Development Corporation performed a basic design since 1973 Fiscal Year, and a plant is completed in March 1982 at Iwaki City, Fukushima Prefecture, and subsequently an operation research was started in April. The plant includes following stages: (1) A coal pulverized below 1 mm is heated to 200°C and mixed with heavy oil and skimmed to produce a slurry. (2) Adding pressure by a hydrohoist and ejecting in the vicinity of a middle stage of the fluidized bed of the gasifier being mixed with steam for feeding the slurry. (3) When the activators, oxygen and steam are ejected from the underside of the dispersal plates at the bottom of the gasifier, a char in the gasifier reacts with the gasification activators, and being flidized to produce a high temperature gas. And from the research result as of 1982 Fiscal Year, it was learned that a temperature rise at the thermal cracking division results in an improvement of gasifying efficiency and a reduction of coking to an extent. As a result of tests in 1983, a conclusion was obtained so as the steam slurry ratio (STM/CSL) should be reduced whereas the thermal cracking temperature should be raised. (6 figs, 4 tabs)

17553 (NP—8770045, pp 115-134) **Research and development of multipurpose gasification technology. Outline of element technology development.** Nokita, Shynsuke. (Hitachi Ltd., Tokyo, Japan). 20 Sep 1985. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

In Proceedings of parallel sessions for the 5th NEDO general assembly.

This study was performed as a research funded by NEDO. If a gas with a middle degree of calorie and enriched by hydrogen and a carbon monoxide by gasifying coal at high temperature, the process may be applicable in various fields and an extensive use (fuel cell, methanol, city gas, NH_3, chemicals = acetic acid etc.) of coal is feasible. And Hitachi Limited set out a survey on an entrained-bed gasifying process and a basic design of a test reactor in 1980, and completed a PDU in September 1981. And by means of the research by PDU a gasification system with one chamber and 2 stage reaction type reactor was developed. The multi-purpose gasifying reactor to be developed is composed of (a) gasifier (b) slug cooler (c) heat recovery division, and is characterized by: (1) rotating flow system (2) multi-stage burner system (3) powdered coal gaseous flow conveying system (4) water cooled wall / refractories construction (5) water cooled wall construction. In order to confirm the characteristic from an engineering point of view, in the element research a cold model and a hot model are used for the research on (1), (2) and (3). A material development is under research for (4), and the present boiler technology is applicable for (5). As an equal distributor for coal, a rotating distributor which may be made smaller by adding pressure was developed. A burner survey was performed in 1983 fiscal year, and a coal burner test facility was installed and the burner made for trial was evaluated by a water flow model and the burner test facility. As a result, the characteristics of element technologies and the basic construction of the equipment were clarified. (16 figs, 2 tabs)

17554 (NP—8770046, pp 174-181) **Development of technology for coal gasification (high-calorific gas). Development of technology for high-calorific gas production; investigation and selection of optimum gasification process; study on 7,000 N m^3/d gasification plant.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

The objective of this program is to develop a 7,000 Nm/d high-calorific gasification plant of fluidized bed type. It started in FY 1976. 500-hour continuous operation test was carried out in FY 1984 and gasification efficiency reached to 70 %. Based on these results, the following were conducted in FY 1985. (1) Long time continuous operation : 500 hours (2) Feed rate fluctuation test to verify operating characteristics (oxygen ratio, steam ratio, bed height, gasification temperature and pressure) (3) Gasification test of imported coals. The results proved that continuous operation was achieved with gasification efficiency above 70 %, that operating characteristics were good enough within designed conditions and that this process had the adaptability for a wide variety of coals. (1 fig, 1 tab)

17555 (NP—8770046, pp 182-189) **Development of technology for coal gasification (high-calorific gas). Development of technology for high-calorific gas production; investigation and selection of optimum gasification process; study on small scale plant.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO annual report.

Development of technology permitting stable feed of raw material coal, realizing stable downward discharge of slag, and for obtaining improved coal burner, were continued, based on the results of investigation performed in FY 1983 and 1984. As the results, conditions for the transportation of coal by the carrier gas to a gasification furnace, conditions for realizing uniform distribution of coal to the furnace, have been established, and successful results concerning improvement of automatic control system for coal feed rate, selection of a slag tap structure suitable for realizing stable downward discharge of slag, relation between the shape of flame during coal combustion under pressure and burner structure, influence of burner structure on mixing characteristic of oxygen with coal, possibility for forming stable rotational flow flame using four burners, etc. have been obtained. Based on the above described results, a basic plan for constructing a 50 t/d pilot plant has been provided, which is a one-chamber-two stage type rotating flame plant for gasification under 30 kg/cm^2G pressure. (4 figs)

17556 (NP—8770046, pp 190-197) **Development of technology for coal gasification (high-calorific gas). Development of technology for high-calorific gas production; feasibility study on large scale gasification plant.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

Based on the result of the investigation using 7,000 Nm^3/d plant and the investigation on the improvement of hybrid gasification process using coal-heavy oil mixture, economic problems of a large scale plant to be constructed in China have been studied. The object of the study was 5(Nm^3/d (3,500 kcal/Nm^3) x 3 systems, 10 kg/cm^2G plant using Chinese coal and heavy oil, consisting (1) pressurized fluidized bed gastification plant for coal-heavy oil slurry, (2) pressurized fluidized bed gastification plant for coal alone (including a methanation plant), and (3) pressurized fluidized bed gasification plant (without including methanation plant). The calculated scope of the installation ranges from coal unloading equipments to gas outlet. The installation cost for (1), (2), and (3) are: (1) 43660 million yen, (2) 56170 million yen, (3) 52310 million yen, and land cost is 1242 million yen for each (1) - (3). The production cost of gas was calculated on the basis of unit prices, etc. described hereunder: Variable cost: (coal 9,000 yen/ton, heavy oil 45,000 yen/ton, electric power 11.7 yen/KWh, water 10.8 yen/ton), Fixed cost: (repayment 20 years, which was estimated as 5 % of the fixed cost; interest: 2.4 %/year, laborer: i.e. 183,600 yen/man year labor cost; administration cost for products: estimated as 8 % of the variable coat; when annual operation rate of plant is 65.7 % caculated production cost of gas were (1): 9.46 yen/10^3kcal, (2):8.82 yen/10^3kcal, (3):8.03 yen/10^3kcal,which are relatively high due to relatively high installation cost and relatively low annual operation rate of the plant. Calculations were also done for cases of enlarged scale of the plant, reduced unit prices of raw materials, and improved rate of operation of the plant. Cost reduction may be expected, which should be investigated as important problems. (1 fig, 2 tabs)

17557 (NP—8770046, pp 198-209) **Development and manufacture of equipment and material for plant.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

Based on corrosion and wear tests on coal gasifier materials, evaluation was made on IWAKI 7,000 Nm^3/d plant and new materials were produced in order to select construction materials. (1) Regarding corrosion due to high temp.-high pressure, studies were made on damage evaluation techniques, effects of process factors and environmental gas concentration, aluminum additives on existing Fe-Ni-Cr alloys, etc. (FY 1981-1984). During FY 1985, tests were carried out extending to 1,000 hours with max. temp. of 850°C and thermodynamically, it was elucidated that with the addition of Al, Cr2O3 stabilizes. (2) Regarding erosion by high temperature particles, evaluation techniques; effects of temperature, particle velocity, exposure time, kind of particle and particle size, etc., were studied (FY 1982-1984). During FY 1985, from the study about relation between time and wear, it is proved that Al additives were satisfactory and even under corrosive atmosphere, increase of wear was small. (3) Regarding field research, material exposure tests, damage analysis were done using test material (FY 1981-1983). In 1985 erosion test proved 18Cr-8Ni steel including 2% Aluminium was aplicable for gasifier. On the other hand, it was learned that SUS 304 was effective in resistance to stress corrosion cracking. (3 figs)

17558 (NP—8770046, pp 210-217) **Development and manufacture of equipment and material for plant. Research and development of refractories-ceramics for multi-purpose high temperature gasification plant.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

Research and development of refractories-ceramics for multi-purpose high temperature gasification plant. In the early 1980's with the aim of proposing construction plans of a 50t/d plant, raw material composition and calcination conditions, evaluation of anti-slag formation and heat properties of furnace wall lining materials were carried out (FY 1983-1984). (1) Regarding trial production of refractories, during FY 1985, it was found that: (a) For picrochromites, electrocasting method by addition of constituting component of glass phase was aplicable and in sintering process that spalling property and slag resistances could be improved by substituting a part of the Al_2O_3 with ZrO_2. (b) For high chromium series, refractory of 80 % Cr_2O_3 showed 30 % improvement in slag resistance compared with zircon-chrome. (c) For self-sintering type SiC with adition of 0.5 % $MoSi_2$ oxidation resistance in atm of 1600 'C was excellent. (2) Regarding slag resistance, a trial product has better property than existing products. (3) Regarding cooling refractory wall, thermal properties of candidate refractories were evaluated and in the evaluation of thermal stress cracking based on sectional models, there were absolutely no defects of various monolithic refractories. The construction method was satisfactory for double layer construction with stamp material. (4) Trial products of ceramic materials showed improved slag resistance. (1 fig)

17559 **(ORNL/SGMP—87/2) Surface Gasification Materials Program: Semiannual progress report for the period ending September 30, 1987.** (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006058/JAW.

The objective of the Surface Gasification Materials Program is to conduct research and development on materials for application to the specific needs of coal gasification systems. One of the goals of the program is to evaluate innovative fabrication methods which have the potential to lower costs and improve reliability and safety for gasifier vessels and components. Another goal is to conduct engineering-scale development and application of materials for coal gasification systems to ensure that the materials of construction for pilot plants and future large-scale plants can be properly selected and specified. Under its lead role for fossil energy materials, the Oak Ridge Operations Office (ORO), with technical support from the Oak Ridge National Laboratory (ORNL), is responsible to METC for the planning, implementation, and management of the program in accordance with guidance received from METC. The organizational relationship between DOE Headquarters, METC, ORO, and ORNL for the management of the Program is illustrated in Fig. 1. The ORNL Fossil Energy Materials Program Office compiles and issues this combined semiannual progress report from camera-ready copies submitted by each of the participating organizations.

17560 **(ORNL/Sub—80-09006/01) Thermodynamic properties and phase relations for refractory-slag reactions in slagging coal gasifiers.** Muan, A. (Pennsylvania State Univ., University Park (USA). Coll. of Earth and Mineral Sciences). Dec 1987. Contract AC05-84OR21400. 110p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88006034/JAW.

The objective of the present research was to provide the data-base and understanding of the chemical parameters needed for prediction and evaluation of the performance of refractory materials under the conditions prevailing in slagging gasifiers. Testing of refractories under atmospheric conditions closely resembling those of slagging coal gasifiers has established that chromium oxide-containing refractories show particular promise in high-temperature gasification because of their high resistance to slagging attack. Consequently, the high-temperature behavior of chromium in crystalline and liquid oxide/silicate systems has been a main focus of this research project. In addition, studies of other high-temperature materials, mainly ZrO_2 in various combinations with other oxide components (e.g., CaO, MgO, Al_2O_3, Cr_2O_3, TiO_2), have been carried out in order to ascertain the potential and chemical constraints of such materials. The main emphasis in this research has been on equilibrium aspects of high-temperature reactions, supplemented with a relatively small amount of work on kinetic aspects of such reactions. The equilibrium studies may be conveniently divided into two groups, viz., investigations of phase relations in multicomponent refractory-slag model systems, and investigations of thermodynamic properties (activity-composition relations) of individual phases. The main focus of the thermodynamic studies was the determination and interpretation of activity-composition relations of chromium oxide and Al_2O_3 in silicate melts of interest in slagging coal gasifiers. This was accomplished mainly by studying the equilibrium between chromium oxide in silicate melts and chromium metal in Pt-Cr alloys in a gas phase of known oxygen pressure. 15 refs., 52 figs.

17561 **(PB—88-127592/XAB) Cool-Water Coal Gasification Program: Environmental Monitoring Plan Commissioning Phase, final report. Volume 1. Technical report, Volume 2. Appendix A - HRSG (heat recovery steam generator) stack-testing results. Volume 3. Appendix B - analytical results. Appendix C - sampling analytical methods. Appendix D - ambient air monitoring data. Volume 4. Appendix E - quality assurance/quality control. Technical report.** (Cool Water Coal Gasification Program, Daggett, CA (USA)). 11 Oct 1985. 1271p. NTIS, PC A99/MF E08.

Also pub. as Radian Corp., Austin, TX. Rept. No. DCN-85-218-032-51; Portions of this document are not fully legible.

The Cool Water Coal Gasification Program (CWCGP) began electrical production under the terms of the Price Guarantee Commitment with the U.S. Synthetic Fuels Corporation (SFC) on June 24, 1984. An Environmental Monitoring Plan (EMP) approved by the SFC was initiated at that time. The Commissioning Phase, the first of four phases of the EMP, was conducted from June 24 through December 31, 1984. Sampling and analysis of compliance and supplemental parameters produced over 1100 samples and 8500 data points from 17 aqueous, ten gaseous, and four solid sampling streams. The technical report includes a description of the CWCGP process as it was operated during the Commissioning Phase, a summary of process changes that occurred during the period, their effect on the environmental monitoring effort, and details of pollution-control testing (Appendix A), data calculations (Appendix B), analytical methods and results (Appendix C), ambient-air-monitoring data (Appendix D), and quality-assurance/quality-control program results (Appendix E).

17562 **(PB—88-142104/XAB) Development of Coal Conversion Catalysts. Annual report, January-December 1982.** (Catalysis Research Corp., Palisades Park, NJ (USA)). Jul 1983. 35p. NTIS, PC A03/MF A01.

See also report for 1983, PB—85-118487.

A series of novel catalyst formulations GRI-C-600 was developed for the direct methanation process. These formulations showed significant improvement in the performance over the previous GRI-C-528 catalysts. The durability of these new catalysts was demonstrated at operating temperatures of up to 1200 F and also at hydrogen to carbon monoxide ratios as low as 0.1 with no water (steam) addition. No carbon formation was detected at these extreme conditions.

17563 **Great Plains Gasification Plant improvement study.** Hoskins, W.W.; Donaldson, A.M.; Kuhn, A.K.; Watt, D.M. (Stearns Roger Div., United Engineers and Constructors, Inc.). pp 40-50 of Proceedings of the 4th annual Pittsburgh coal conference. Greensburg, PA; MEMS (1987). (CONF-870942—).

From 4. annual Pittsburgh coal conference; Pittsburgh, PA, USA (28 Sep 1987).

The Great Plains Gasification Plant (GPGP), located near Beulah, North Dakota produces synthetic natural gas from North Dakota lignite. The lignite is gasified in Lurgi moving bed gasifiers, which require screening of fines. The fines not processed by the Lurgi gasifiers are sold to Basin Electric (fines are burned in Basin Electric's adjacent power plant). The Lurgi gasifiers also produce byproduct coal liquids that are currently burned in Riley boilers to generate the steam needed by the GPGP plant. The U.S. Department of Energy (current owner of the GPGP) is in the process of selling the plant. As part of the sale process, consideration was given to a number of options for improving plant revenues. One of the potential options identified by the GPGP management was marketing portions of the current liquid byproducts, crude phenol, tar oil and naphtha, as upgraded byproducts. Replacement fuel energy could come from utilization of lignite fines. Early this year, the

U.S. Department of Energy (sponsor) authorized Stearns-Roger to evaluate technologies that would use some of the fines within the GPGP facilities. The intent of the study was to identify possible economic benefits that prospective buyers could derive from utilizing lignite fines.

17564 **Environmental assessments of developing coal conversion technologies: Where are the data.** Roseberry, L.M. (Oak Ridge National Lab., Oak Ridge, TN 37830). pp 734-743 of Proceedings of the 4th annual Pittsburgh coal conference. Greensburg, PA; MEMS (1987). (CONF-870942—).

From 4. annual Pittsburgh coal conference; Pittsburgh, PA, USA (28 Sep 1987).

A recent online search of DOE's Energy Data Base gave a revealing answer to the question "Where are the data with which to do environmental assessments of emerging coal conversion technologies?" For the past five years, 50% of the public literature concerning the environment and fossil energy sources, excluding petroleum, has appeared in journals. Reports are the second major publication type with 32% of the total citations. While the journal literature discusses research issues of fossil energy, the project reports make available to the public the detailed data which is the meat of environmental assessments. The Fossil Energy Environmental, Health, and Safety Information System contains a distillation of data on industry-DOE co-sponsored projects of recent years. The Fossil Energy Technology Environmental Program (FETEP), an activity of the Fossil Energy Program at Oak Ridge National Laboratory (ORNL), was originally conceived to assess the environmental, health, and safety (EH and S) research and development data generated by the U.S. Department of Energy (DOE) Office of Fossil Energy and Energy Research, the U.S. Environmental Protection Agency (EPA), and other agencies involved in direct coal liquefaction. A concurrent activity of FETEP was the development of a computer-based information system to preserve the material generated during the assessments. The Fossil Energy Information Task group, a component of the Information Research and Analysis Section, Biology Division, ORNL, designed and implemented the system. A survey was conducted of ORNL staff members identified as potential users of the system, and their perceived needs and expectations were carefully factored into the design.

17565 (DOE/METC—86/6043, pp 368-372) **Production of hydrogen from low-rank coal.** Sears, R.E.; Timpe, R.C. (Univ. of North Dakota, Grand Forks). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract FC21-86MC10637.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The objective of this research is to evaluate the technical feasibility of producing low-cost hydrogen by catalytic steam gasification of low-rank coals. This approach takes advantage of the high reactivity, volatile matter, moisture concentrations, and inherent alkali content of low-rank coals. Bench-scale investigations of low-rank coal steam gasification have already shown product gas compositions and reaction kinetics favorable to hydrogen production. This effort will provide a proof-of-concept and early stages of engineering development using a continuous process unit (CPU).

17566 **(DOE/PC/60036—11) Supercritical fluid extraction of coal: Technical progress report, March 1, 1986-May 31, 1986.** Greenkorn, R.A.; Chao, K.C. (Purdue Univ., Lafayette, IN (USA). School of Chemical Engineering). 1986. Contract FG22-83PC60036. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005598/JAW.

This is the eleventh progress report on Supercritical Fluid Extraction of Coal. The objective is to study the extraction of coal with supercritical aromatic mixtures with ammonia as an additive. The experimental apparatus is being readied to study extraction of Wyodak subbituminous coal and Illinois No. 6 bituminous coal with gaseous ammonia dissolved in tetralin and 1-methylnaphthalene. A group contribution form of the Soave equation is being investigated. The need to consider scaling effects near the critical point is being studied. 9 refs., 1 fig.

17567 **(DOE/PC/80023—T11) Development of an in-situ hydrogen measuring instrument for coal liquefaction processes: Quarterly report, October 1987-December 1987.** Klinzing, G.E. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). 1987. Contract AC22-85PC80023. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004349/JAW.

The research activity during this quarter focused on the experiments carried out to determine if the donor solvent liquids released any hydrogen during their exposure to liquefaction conditions of high temperature and pressure. After conditioning the apparatus testing commenced and showed that indeed the Lummus coal liquid tested as well as the tetralin model liqiud did liberate hydrogen as detected by the in-situ hydrogen probe. The activity that took place in Wilsonville during this time was one of preparing the plant for start-up which began in late December. A new probe was inserted at that time and data will be taken during the first weeks of January. 4 figs.

17568 **(DOE/PC/80908—6) Low severity coal conversion by ionic hydrogenation: Report for the period October-December 1987.** Cheng, J.C.; Larsen, J.W. (Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry). 16 Dec 1987. Contract FG22-85PC80908. 9p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88004015/JAW.

Two objectives of this study were: (1) to examine the ionic hydrogenation of low rank coals using H_2O:BF_3 as the acid and hydrogen gas as the hydride donor in the presence of catalytic quantites of transition metal complexes to activate hydrogen, and (2) to develop optimum reaction conditions. The catalyst used was $(CH_3CN)_2PtCl_2$. The effect of aromatic thiols, sulfides and thiophenes on the catalyst was investigated. A group of polynuclear aromatic compounds was selected to study and improve the reaction conditions. 9 refs., 1 tab. (CS)

17569 **(DOE/PC/90508—T4) Narrow boiling distillates of coal liquefaction products: Part 3, Critical properties: Quarterly report, October 1, 1987 to December 31, 1987.** Allen, D.T.; Vajdi, L.E. (California Univ., Los Angeles (USA). Dept. of Chemical Engineering). 1987. Contract FG22-86PC90508. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004278/JAW.

Critical properties of narrow boiling and wide boiling coal distillates were estimated using correlations and a group contribution method. The critical property estimates were compared to critical properties regressed from hydrogen solubility data. The correlations provided more accurate predictions of the critical temperature than the group contribution method; none of the methods gave accurate estimates of critical pressure. While the group contribution method did not yield the best estimates of critical properties, it did allow an evaluation of the sensitivity of the critical properties to structural features in the coal liquids. The results indicate that the critical properties are not sensitive to the fine details of the coal structure but do depend on global features such as aromatic content and the concentration of phenolic compounds. 10 refs., 11 tabs.

17570 **(DOE/PC/90521—T4) Role of porosity in supercritical fluid extraction of coal: Technical progress report, December 15, 1987.** Bale, H.D. (North Dakota Univ., Grand Forks (USA). Dept. of Physics). 15 Dec 1987. Contract FG22-86PC90521. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003818/JAW.

Previously in the initial scattering experiments on Beulah lignite was discussed. The primary effect of supercritical extraction, SCE, on the scattering pattern was the appearance of a shoulder at the larger small angles. This additional scattering was attributed to the formation of an extensive new micropore structure. In the past months we have continued our scattering experiments on Beulah lignite and begun our study of Wyodak subbituminous coal. Work on the extract composition is progressing at the UNDERC and a brief account of their work is included as an appendix to this report.

17571 **(DOE/PC/90523—12) Phase equilibrium data for development of correlations for coal fluids: Report for the period August 15, 1987 to December 31, 1987.** Robinson, R.L. Jr.; Gasem, K.A.M.; Raff, A.M.; Qin, Yanlong. (Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering). 19 Jan 1988. Contract FG22-86PC90523. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004833/JAW.

During the present report period, data have been obtained on the solubilities of carbon dioxide in benzene at 310.2 K, and of ethane in n-hexatriacontane at 373.2 K and in n-tetratetracontane at 373.2 K and 423.2 K. These data are well described by the Soave and Peng-Robinson equations of state. Also, during this report period a low pressure recirculating vapor-liquid equilibrium still has been designed and constructed. Preliminary tests on selected systems confirm excellent operation of the new apparatus. 17 refs., 7 figs., 10 tabs.

17572 **(DOE/PC/90528—T3) Thermodynamics of coal liquid/solid systems: Quarterly progress report, June 16, 1987-September 15, 1987.** Holder, G.D. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). Jan 1988. Contract FG22-86PC90528. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005297/JAW.

An extensive pure component data base has been developed by Starling and coworkers. This data base has been extended to include several binary systems by many coworkers including ourselves. We are currently investigating the effect of coal solids on the vapor pressure of multicomponent systems containing coal solids. The results obtained thus far indicate a dramatic effect of the coal solids on vapor pressure of coal liquids. A 50 percent increase in the vapor pressure of a liquid from the Wilsonville pilot plant was observed when coal solids were added. This effect is attributed to the adsorption of heavier liquid components on the coal surface, as these heavies are preferentially absorbed, leaving a lighter liquid solution with a higher vapor pressure. The adsorption of heavy components results in sharper and easier separation of the lighter unadsorbed liquid. Chemical reactions are also affected by the adsorption of the heavier components as they become unavoidable for conversion to lighter compounds. This work aims to quantify the effect of this adsorption through a methodical study of the properties of both heavy liquid model compounds and actual coal liquids with and without coal solids. 21 refs.

17573 **(DOE/PC/90534—8) Supercritical fluid chromatography/supersonic jet spectroscopy: Progress report, September 1, 1987-November 30, 1987.** Goates, S.R.; Lee, M.L. (Brigham Young Univ., Provo, UT (USA). Dept. of Chemistry). 1987. Contract FG22-86PC90534. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004438/JAW.

The thermal gradient of the heated nozzle interface was measured with the use of a thermocouple probe and this proved useful in characterizing configurations of the sheath nozzles. Further testing of the back-sealed pinhole restrictor resulted in a rejection of this configuration because of alignment difficulties with the pinhole. The adaptation of sheath flow nozzles for supersonic jet expansions with supercritical fluids is discussed along with the porous frit restrictor and electrical feedthroughs. Pulsed nozzle designs have also been studied and will be the object of further research. 2 figs. (FI)

17574 **(DOE/PC/90538—5) Use of basic nitrogen to chemically clean coal: Quarterly report No. 4 for the period September 15, 1987 to December 15, 1987.** Silver, H.F. (Wyoming Univ., Laramie (USA). Dept. of Chemical Engineering). 4 Jan 1988. Contract FG22-86PC90538. 9p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88004455/JAW.

Work was initiated to evaluate the effect of basic nitrogen compound concentration in a coal derived solvent on pyridine conversion and on sulfur removal from a North Dakota lignite, a Wyoming subbituminous coal and a Kentucky bituminous coal. The effect of reaction variables on the desulfurization and liquefaction of these coals was established. Four different sterically hindered, basic nitrogen compounds were then added to the coal derived distillate solvents. Results were analyzed to determine which of the nitrogen bases had the greatest effect in promoting desulfurization and liquefaction. None removed more than 40 wt % of the sulfur from any of the coals studied and conversions to pyridine soluble liquids were below 60 wt %. One of the more effective basic nitrogen compounds, 2,2,6,6-tetramethylpiperidine (TMP) was added to coal derived distillate solvents to provide a coal:solvent:TMP weight ratio of 1.0:1.5:0.5. Dried coals were then desulfurized under a hydrogen atmosphere. No definite trend in the extent of the desulfurization reaction could be attributed to increasing the weight ratio of TMP to solvent. Increasing this weight ratio had a negative effect on the conversion of coal to pyridine soluble product. 2 tabs.

17575 **(DOE/PC/90908—T4) Factors controlling hydrogenolysis in coal liquefaction: Quarterly report No. 5, July 1, 1987-September 30, 1987.** McMillen, D.F.; Malhotra, R.; Tse, D.S.; Nigenda, S.E. (SRI International, Menlo Park, CA (USA). Chemical Kinetics Dept.). Jan 1988. Contract FG22-86PC90908. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004540/JAW.

The objective of the study was to determine in greater detail the factors affecting solvent-mediated hydrogenolyses. This would provide a better understanding of, and ability to manipulate, such induced bond scissions in actual coal liquefaction. Cleavage rates of suitable model compounds in a variety of solvent systems with and without added coals were investigated, thereby assessing the relative importance of hydrogenolysis via free H-atoms and via radical hydrogen-transfer (RHT). We focused on extension of our numerical modeling effort to include (1) the effects of hydrogen transfer among solvent structures on the effectiveness of liquefaction catalysts, (2) liquefaction under shuttling conditions, and (3) dependence of H-transfer-induced cleavage on coal structure cluster size. 5 refs., 7 figs.

17576 **(DOE/PC/90909—T5) Low severity coal liquefaction using homogeneous basic nitrogen catalysts: Technical progress report, August-October 1987.** Miller, R.L.; Baldwin, R.M. (Colorado School of Mines, Golden (USA). Dept. of Chemical Engineering and Petroleum Refining). 1987. Contract FG22-86PC90909. 21p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004456/JAW.

Work continued to evaluate five identified methods for potentially reducing nitrogen adduction and thermal degradation during low severity liquefaction. Results from runs using Kentucky 9 bituminous coal and Wyodak subbituminous coal suggest that 1,2,3,4-tetrahydroquinoline and dipropylamine enhance both coal conversion and distillate yield at low severity conditions. Neither model compound was found to adduct into residual liquefaction products. Conversely, each of the five remaining model nitrogen compounds evaluated (7,8-benzoquinoline, piperidine, 4-piperidinopyridine, 5,6-benzoquinoline, and diphenylamine) became adducted and, as a result, liquid yields sharply decreased in runs using these compounds. At the low severity reactions studied, Kentucky 9 coal conversion and liquid yield levels were increased slightly by replacing CO/H_2O feed gas with H_2. 3 refs., 8 figs., 5 tabs.

17577 **(DOE/PC/90911—T1) Reactivity of heteroatom-containing organics during liquefaction of subbituminous coal: Quarterly technical progress report, September 15, 1987-December 15, 1987.** Aulich, T.R.; Hawthorne, S.B.; Knudson, C.L. (North Dakota Univ., Grand Forks (USA). Energy and Mineral Research Center). 1987. Contract FG22-86PC90911. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004006/JAW.

The objective of this research project is to provide a greater understanding of the role of heteroatom-containing species in coal reactivity during liquefaction. Work during the last quarterly report period focused on evaluating previous results, and discussing and planning the reaction conditions and experiments for subsequent tests. Tubing bomb reactions for the preparation of 500 to 1000 mg quantities of deuterated heteroatom-containing species to be used as tracers in liquefaction tests are scheduled for January, 1988. Following these syntheses, and the preparation of 20 grams of 99%

isotopically pure, deuterated A04 liquefaction solvent, work will focus on completion of a tubing bomb liquefaction test matrix.

17578 (DOE/PETC/QTR—87/2) **[Pittsburgh Energy Technology Center]: Quarterly technical progress report for the period ending March 31, 1987.** (USDOE Pittsburgh Energy Technology Center, PA). Nov 1987. 170p. NTIS, PC A08. Order Number DE88003942/JAW.

Studies in advanced coal research are presented. Included are the following: coal science programs; coal preparation and combustion kinetics; advanced technology in liquefaction, including direct and indirect liquefaction; alternative fuels; advanced combustion technology; flue gas cleanup; environmental coordination, technology transfer, and clean coal demonstration program. (CBS)

17579 (NP—8770039, pp 95-110) **Outline of research program of bituminous coal liquefaction using 1.0 t/d PSU.** Kusaka, Kenichi. (Nippon steel Corp., Tokyo, Japan). 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

This is an annual report of the fiscal year 1985 on a PSU of 1.0 t/d required for development of NEDOL process on bituminous coal liquefaction. New Energy Development Organization (NEDO) combined many liquefaction technologys of bituminous coal as NEDOL Process , and the program is in the startpoint of pilotplant ending the study of PDU. Basic plan for research and development of NEDOL Process is intended to hydrogenate heavy elements up to 538 deg. C. in a fixed bed type reaction column under liquefaction condition of temperature;430 - 460 deg. C, pressure: 150 - 200 kg/cm^2 to obtain hydrogen supplying recycle solvent so that it will achieve the yield of over 40 weight % for naphtha (05 - 220 deg C.) and light and middle oil of intermediate distillate (220 - 350 deg. C.) and total yield of liquefaction (05 - 538 deg. C.) of over 50 weight %. PSU is composed of element process of same stages as those of pilot plant. And PSU research conference was established between NEDO and 3 entrusted companies. Main installation of PSU is composed of coal storage and preliminary processing division, liquefaction reaction division, liquefied oil distillation division, solvent hydrogenation division and gas treatment division. Design Specification is as follows. a coal processing capacity; 1.0 t/day standard coal for design; Wandoan coal Liquefaction equipments; 450 deg. C in temperature, 170 kg/cm^2 in perssure, solvent/coal ratio of 1.5. (4 Figs, 1 tab)

17580 (NP—8770039, pp 111-126) **Development of equipment for coal liquefaction plant.** Ishiguro, Touru. (The Japan Steel Works, Ltd., Tokyo, Japan). 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

This is an annual report of the fiscal year 1985 on development of reactor material required for NEDOL Process on bituminous coal liquefaction. In order to establish general background of manufacturing large reactor required for commercial scale liquefaction process, development of steel for a pressure vessel with high creep rupture strength was performed in the order of basic research, trial manufacture research, design, evaluation of strength against environment and standardization. Selected alloy contains 3% Cr with an additive of 0.25% V and this alloy was considered to have improved property in creep rupture strength and hydrogen erosion ressistance. The pressure vessel made of this alloy has an uniform strength and toughness was assured. In trial manufacture research, experimental steel ingot was used with a size annually increased from 50kg, then 80t and to 250t applying stainless steel overlay welding. The rupture strength for 100,000 hours of developed material has a value about 50% higher than existing 3 Cr - 1 Mo steel. The developed material was approved as a standard ASTM material in its Code Book issued in 1985. The developed material has a sufficient resistivity against hydrogen erosion and hydrogen rupture also, thereby a general background for manufacure of reactor vessel for a commercial scale liquefaction plant in the future was established. (13 figs, 3 tabs)

17581 (NP—8770044, pp 54-84) **Development of brown coal liquefaction technology.** Nakago, Takao. (Nippon Brown Coal Liqufaction Co. Ltd.). 21 Sep 1984. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

In Proceedings of parallel sessions for the 4th NEDO general assembly.

This is a contracted NEDO project. An experiment was carried out to obtain the necessary data for the construction and the operation of a 50 t/d pilot plant for the optimized liquefaction process for the Australian Victorian brown coal. 1) Yield of the liquefied oil increases significantly up to 50 wt% CLB recycle per maf brown coal. However, no further effect is attained even at 100 wt%. 2) CLB dissolving power of the secondary hydrogenated naphtha lay between those of cyclohexane and cyclohexane-toluene mixture. Preasphltenes was almost removed showing only less than 10 % in the recovered DAO. 3) The operation was stable even when the reaction pressure was reduced from 250 kg/cm^2 down to 200 kg/cm^2 and even to 150 kg/cm^2. The lowering of the reaction pressure reduces the rate of DAO decomposition and the rate of DAO hydrogenation, especially at 150 kg/cm^2. 4) In the study of dehydrating crude brown coal, an equation for an overall heat transfer coefficient was obtained from the effect of flow rate of slurry, pipe size and the ratio of solvent to brown coal. 5) In the primary hydrogenation, higher temperature gives higher yield of the liquefied oil. More than 50 % of overall recovery yield of liquefied oil can be expected. (19 figs, 1 tab)

17582 (NP—8770044, pp 85-94) **Bituminous coal liquefaction program.** Takase, Ikuya. (New Energy Development Organization, Tokyo, Japan). 21 Sep 1984. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

In Proceeding of parallel sessions for the 4th NEDO general assembly.

This is one of the major programs concerning the coal liquefaction technology which stands in the central position in the NEDO project of energy development of petroleum substitute (a main theme of the Sunshine Project). Basic outlook of this program is as follows: 1) The existing three processes (direct hydrogenetion liquefaction process, solvent extraction process, solvolysis luquefaction process) are to be integrated into one process, and a new coal liquefaction process, NEDOL, will be put into practice and promoted. 2) Although thid program is under the responsibility of NEDO, its design, construction, operation and research will be executed by a R and D company whose stocks are jointly owned by private enterprises. 3) Basic research and supporting research will be entrusted with appropriate companies by NEDO. 4) Private companies will bear 10 - 15 % of the total research cost of 100 billion yen. 5) Period of the development is 9 years from 1984, 3 years out of which from 1990 being for the research by operating the equipments. (1 fig, 4 tabs)

17583 (NP—8770044, pp 95-114) **Research and development of hydrohoist for coal liquefaction.** Ohashi, Motohiro. (Hitachi Ltd., Tokyo, Japan). 21 Sep 1984. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

In Proceedings of parallel sessions for the 4th NEDO general assembly.

This study was performed as a research funded by NEDO. For a PDU required for coal liquefaction, troubles associated to wear, corrosion, coking etc. are becoming serious problems. And a hydrohoist with high reliability was taken up as an object of R and D for a large scaled pilot plant of the 250 ton capacity. Main features of the hydrohoist are as described below: (1) A high pressure transportation usually difficult by a centrifugal type slurry pump, and also a slurry transportation of a large capacity is attainable. (2) Wear is small and the maintenance cost is low. The outline of the hydrohoist as applied to a liquefaction plant is as follows: (1) A slurry composed of coal, catalyst and solvent is fed a feeding chamber of the hydrohoist. (2) Then, a liquefied reaction product is separated from the gas-liquid mixture, and the high pressure liquid is pressurized by a booster pump using the same liquid for a driving liquid, so as to be fed the feeding chamber and the feed-stock slurry is forced out to the liquefaction reactor side. (3) The driving liquid

is fed a low pressure liquid and gas separation system reducing pressure by means of a valve in the feeding chamber. A basic experimental facility was designed and built in a period from 1980 to 1982, and by performing an operation test with the facility, it was learned that the product slurry is good for use as a driving liquid where a power recovery is required. (9 figs, 4 tabs)

17584 (NP—8770045, pp 103-114) **Outline of development for coal liquefaction technology by cooperation of Japan and China.** Murata, Katsuhide. (Mitsui Engineering and Shipbuilding Co. Ltd.). 20 Sep 1985. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

In Proceedings of parallel sessions for the 5th NEDO general assembly.

This study was performed as a research funded by NEDO. The Japanese organization in charge of the execution of the Japan PRC joint development venture for coal liquefaction technologies is New Energy Development Organization (NEDO), and the PRC organization in charge is Coal Science Research Institute. The Japan PRC coal liquefaction joint development venture program is divided to two details by contents: one up to the contract signing and the other on the construction of a small continuous liquefaction plant and the subsequent operation. And the purpose of the joint venture is to perform a research on liquefaction characteristic for the coal species chosen for liquefaction among several hundreds of coal species in PRC by means of the cooperative work of Japan and PRC so as to select the coal species suitable for liquefaction. And the agreements stipulated the division of work to be undertaken by the PRC side (Coal Science Research Institute) and the Japanese side (NEDO). The small continuous test facility to be offered by the Japanese side is intended to obtain a liquefied product by cracking with hydrogenation coal of an oil slurry form under high temperature and pressure, and this is a direct hydrogenation liquefaction of the coal. And in this manner, the coal is processed at a rate of 0.1 t/d on a dry coal base. The conclusion obtained by the test performed by 1984 is as follows: (1) On Bei-su coal (Shantong), there is no great difference for conversion ratio and oil yield by adding sulfur and the addition of sulfur is unnecessary. (2) The PRC coals tested till now are not suitable for liquefaction purpose (the conversion ratio of the Wandoan coal is 95% while they have the range of 77 - 88%) (2 figs, 6 tabs)

17585 (NP—8770046, pp 7-15) **Development of technology for bituminous coal liquefaction. Supporting research for pilot plant; research using experimental plant; research using 2.4t/d plant.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This annual report for FY 1985 covers the development project of the NEDOL-Coal Lquefaction Process with bituminous coal. Operational study was carried out using experimental plants, aiming at practical application of bituminous coal liquefaction techniques. Thereby, design, fabrication and technical data necessary for operation of a commercial plant have been obtained. A 2.4 t/d experimental plant has been employed as testing unit, and as samples Horonai coal and 3 other kinds of coal have been used. 9 Runs were carried out, including red mud + sulfur catalyst run, synthetic iron sulfide catalyst run and the total operational time was 2,634 hours. In the operation study, neutron attenuation agent was injected from the lower part of the reacter, the variation of neutron count was determined and innumerable process data concerning solvent properties variation were obtained. In the component study, regarding adhesion phenomena of FeS, studies were carried out, based on repeated experiments varying the brands of coal, type of catalyst and flow velocity of slurry over 20-40 hours and qualitative results were attained.(1 fig)

17586 (NP—8770046, pp 16-21) **Development of technology for bituminous coal liquefaction. Supporting research for pilot plant; research using experimental plant; research using 1t/d plant.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

Test runs of the NEDOL process were carried out in a 1 t/d plant, using Wandoan and Illinois No. 6 coals. Under standard liquefaction conditions, liquid product yields of 50 and 45 wt%/daf coal, respectively, were attained, the properties of the recycle solvent were found to be stable, and the relation between gas space velocity: (cm/s) and gas holdup: ϵ g was found to be $\epsilon g = 0.0656Ug + 0.0904$. The modification of the apparatus was done in order to improve the performance of the plant, and the controlability and operability of the plant were achieved. Also, using a small-scale apparatus and a batch type reaction unit, studies were conducted with the aim of extending the applicability of the NEDOL process to a wider variety of coals. The results indicated that Taiheiyo coal are just as suitable as Wandoan coal. Illinois No. 6 coal was found to require more severe liquefaction conditions in order to obtain the same liquid yield as Wandoan coal. Since Illinois No. 6 Monterey coal is a high-sulfur coal, it was ascertained that the quantity of sulfur added as a promoter can be appropriately reduced. The formation of n-paraffin, an undesirable cumulative component of the recycle fluid, was found to be extremely low for Monterey coal, thus, it was evident that the accumulation of this component may be negligible when Illinois No. 6 coal is used. (3 tabs)

17587 (NP—8770046, pp 22-27) **Development of technology for bituminous coal liquefaction. Supporting research for pilot plant; research using experimental plant; research using 1t/d plant; development of coal deashing technology for coal liquefaction.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

Basic investigations concerning 19 types of Japanese coals imported coals were conducted with the objective of improving the liquefaction yield of bituminous coals, decreasing wear and depreciation of equipment and improving the economy of the liqueaction process. The results of sink-float analysys of these coals confirmed that ash removal varied widely, ranging from 20 to 69 wt%, and that deashing efficiency was influenced by coal characteristics. The results of liquefaction tests showed that deashing improved liquefaction properties and that gravity separation was suitable for the preparation method of feed coal of liquefaction process. On the basis of these results, an experimental continuous gravity separation unit centering upon a heavy-medium cyclone was constructed and separation tests of Wandoan coal were conducted. (1) Increases in the feed rate of heavy medium and/or decreases in inlet diameter resulted in improved separation efficiency. Increases in the coal feed rate up to 640 kg/h did not cause any decrease in efficiency. (2) Separation efficiency decreased lowering particle size of coal, however, the degree of difficulty of separation and the oil recovery yield were independent of partical size. (3) In basic experimental tests for removal of chlorine, calcium and magnesium, regarded as harmful for liquefaction plants, 90% of the chlorine content was removed using water in extraction tests conducted at 200°C. However, water extraction of calcium and magnesium was found to be difficult. (4 figs, 2 tabs)

17588 (NP—8770046, pp 28-34) **Development of technology for bituminous coal liquefaction. Supporting research for pilot plant; research using experimental plant; research using 1t/d process support unit (PSU).** (New Energy Development Organization, Tokyo, Japan). Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

Structural layout of 1 t/d PSU plant of coal liquefaction with NEDOL Process was decided according to Research and Development Plan on 1 t/d PSU Liquefaction Plant and Basic Specifications of PSU Configuration on Bituminous Coal Liquefaction. Also basic and detailed designs were completed respectively. The PSU is composed of four sub-units and their steering station, i.e. a) Storage and pretreatment of coal b) Liquefaction reactor c) Distillator of liquefied oil d)Hydrogenating reactor with donor solvents. Operating modes of four sub-units as follows. a) Coal materials which pulverized and dryed previously are mixed with donor solvent and catalyst in defined proportion in the slurry-mix tank. This coal slurry is passed into slurry supply-tank through wet-pulverizer. b) Pressurized by pump feeder, high pressure slurry is mixed with hydrogen gas and heated, then transported to liquefaction column. Reaction products are separated in each fraction. c) Naphtha and middle (normal pressure light oil), and heavy distillates are fraction-

ated under reduced pressure. d) After addition of hydrogen at the donor weighing vessel, heavy compornents in light oil are heated and hydrogenated . Solvents are cooled, separated from oil and gas then most of gas is recycled back into the process. (1 fig.)

17589 (NP—8770046, pp 35-44) **Development of technology for bituminous coal liquefaction. Supporting research for pilot plant; research using a 0.1t/d bench scale unit; research on coal liquefaction condition.** (New Energy Development Organization, Tokyo, Japan). Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This research program started 1987. In the begining much autoclave deta were obtained. A 0.1 t/d bench scale unit (BSU) has been operated since 1980. In the research program of FY 1985, research on liquefaction conditions was succeeded. The results of 0.1 t/d BSU study are as follows. (1) The solvent recycle runs were carried out using Taiheiyo coal and Illinois No. 6 coal. For Taiheiyo coal, oil yields are the same level, but hydrogen consumption and gas make are smaller, compared with these for Wandoan coal. For Illinois No. 6 coal, oil yields are the same level, and hydrogen consumption and gas make are slightly larger, compared with Wondoan coal. (2) The analyses from a long-term solvent recycle run was performed and detailed material balance was obtained. The results of antoclave study are as follows. (1) The applicability of kinetic model for Wandoan, Taiheiyo and Illinois No. 6 coal was validated. (2) Reaction rate of coals was in order of Illinois No. 6, Taiheiyo and Wandoan. (1 fig, 3 tabs)

17590 (NP—8770046, pp 45-51) **Development of technology for bituminous coal liquefaction. Supporting research for pilot plant; research using bench scale plant; investigation of coal liquefaction catalyst.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

In continuation to the investigation done in 1984, investigation was proceeded on the production method of dry-process synthesized, fine particle iron sulfide catalyst to be used for the pilot plant. Conditions for preparation of the catalyst, operation method and operability of devices, were investigated in 1985 for each stage. (1) In the pretreating drying stage, it was concluded that such raw material obtained by combining fluidized drying with pulverization gave better result. (2) In the mixing stage of powdery catalyst materials, mixing method by giving impact at high speed simultaneously to iron-based material and sulfur-based material, was adopted. (3) In the heat-treatment and activation stage, 430°C-600°C reaction temperature and 30 min-60 min retention time were found most preferable for obtaining the highest activity of the catalyst. (4) In the waste gas treating stage, material balance of sulfur was investigated by the determination of generated SOX with a purpose for permitting effective utilization of SOX in future, although the waste gas is treated at present by neutralization. Using the catalyst prepared by the above-described methods, tests were done by means of an autoclave, a continuous testing device for catalyst performance, and a 2.4 t/d PDU, and possibility of the catalyst for liquefying coal at good oil yield and light/medium oil fraction yield, etc. was confirmed. (4 figs, 1 tab)

17591 (NP—8770046, pp 52-59) **Development of technology for bituminous coal liquefaction. Supporting research for pilot plant; research using a bench scale unit; investigation of solvent hydrotreating catalyst.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

Succeeding to the tests done in 1984, preparation of solvent hydrotreating catalysts and screening tests for the catalysts have been carried out in FY 1985. It was concluded that mordenite catalyst (C-60-07) and high silica zeolite catalyst (C-60-12, C-60-13) were suitable because of two functionality in superior cracking activity for n-paraffin and hydrogenation activity for solvent. On one hand, a determination method for the acid density and acid strength discribution basing on the elimination of ammonia at high temperature was established, taking consideration in the close relation between the solid acidic properties of zeolite and the cracking reaction of paraffin. Further, detailed investigation on the hydrocracking caused in the poststage of a two stage reaction tower system, particularly cracking behavior of high boiling n-paraffin made clear that the cracking activity for n-paraffin is the higher, the higher the temperature, and above 90% percentage of cracking was realized at 440°C. Furthermore, a hydrogenation test was done using a novel catalyst which has been developed for hydrogenation of recycle solvent and having high cracking activity for n-paraffin. Fundamental data necessary for process design were collected. As the results of comparison of the two kinds of catalyst, it has been recognized that C-60-12 had extremely higher activity than C-56-2 for n-paraffin hydrocracking at above 380°C. (3 figs, 1 tab)

17592 (NP—8770046, pp 60-67) **Development of technology for bituminous coal liquefaction. Supporting research for pilot plant; research using a bench scale unit; research for optimizaion of the solvent hydrotreating process.** (New Energy Development Organization). Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is an annual report of the fiscal year 1985 for a research project on optimization of solvent hydrotreating process in NEDOL Process of bituminous coal liquefaction. For the purpose of obtaining an optimum systematization in distillation stage of liquefaction process of bituminous coal and achieve an optimum design on heavy solvent for hydrogenation, distilling condition of liquefied oil produced from Wandoan coal was examined and evaluated, and distillation and hydrotreating tests were performed, and quantitative evaluation method on process solvent for hydrogenated Wandoan coal was investigated. According to continuous distillation and solvent hydrotreating tests, reaction rate constant K changes greatly at around 350 deg. C, and with this border the reaction may be arranged to two different hydrogenation rate formula for low temperature zone and high temperature zone. As a result of invenstigations on relationship between various parameters for evaluation of solvent quality and hydrogen consumption, it was recognized that there is a good correlation between specific gravity and refractive index and the effect of hydrogen consumption may be analogized from this reaction. And it was found that the camparative evaluation method of specific gravity and H/C ratio is not controlled by hydrotreating conditions so that it may be used extensively for all liquefied oils. In the meantime, using NEDOL Process, amount of 9,10 hydrogen of 9,10 dihydroantheracene was quantitatively analyzed with 1H-NMR and amount of hydrogen transferable to solvent was relatively examined. The method may be used for evaluation of quality of liquefaction solvent. (4 figs, 2 tabs)

17593 (NP—8770046, pp 68-74) **Basic and detail design of pilot plant for liquefaction of bituminous coal. Development of technology for bituminous coal liquefaction; basic and detailed design of a pilot plant.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is an annual report of the FY 1985 on basic and detail design on a pilot plant for liquefaction of bituminous coal. In order to prove NEDOL process and establish operation technology while obtaining data required for a commercial plant to be built in the future, an operation research program and an installation program were worked out. And investigation and analysis were performed on basic design, detail design and environment etc. of the pilot plant. Moreover, subjects for research on demonstration plant and commercial plant were classified according to tasks on the installation program and coordinated, and on the basis of operation mode and operating condition, a basic operation program was prepared. And operating method assumed was examined while process data and fluidity in unit appliances such as slurry preheating furnace, liquefaction column, etc. and analytical method was standardized. On installation program, basic design including process flow diagram, heat balance etc. detail design including summary report and standard specifications and instrumentation and control system were examined.(1 tab)

17594 (NP—8770046, pp 75-87) **Development of technology for brown coal liquefaction. Supporting research for operation of pilot plant.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

As to the research on support for operation of 50 t/d pilot plant for the development of liquefaction plant of Victoria brown coal in Australia, the studies of the following three items have been done; (1) Studies of optimum operating conditions and operating characteristics of reaction apparatus, (2) Study for prevention of operation troubles, (3) Relations between evaluation and analysis of liquefied oil and operating conditions of secondary hydrogenating processes, following the studies of 5 items that have been done up to this time concerning the research and selection of optimum liquefaction processes. The general descriptions of the results of these studies are reported with use of graphs and tables. On the first theme, three items concerning (1) 10 sub-items for supporting the 50 t/d pilot plant operation, (2) 3 sub-items for supporting the data analysis and process evaluation of the pilot plant are described. On the second theme, 4 items concerning (1) 3 sub-items for primary hydrogenating technique, (2) 4 sub-items for secondary hydrogenating technique, (3) 1 sub-item for analysis of liquefied reactant, (4) 2 sub-items for material test are described. And on the third theme 2 items concerning (1) characteristic tests for liquefied oil and (2) investigation for hydrogenating process are described. (12 figs, 1 tab)

17595 (NP—8770046, pp 88-97) **Development of technology for brown coal liquefaction. Design, construction and operation of pilot plant; development of 50t/d pilot plant.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

As for the development of 50t/d pilot plant for the development of liquefaction plant of Victorian brown coal in Austraria, outline of the contents about the second stage construction following the first stage construction up to this time is reported from the following 4 viewpoints; 1: design of process apparatuses, 2: manufacture of apparatuses, 3: fieldwork of the construction and 4: operation of the first stage facilities. On the first item the outline of detail design made by Japanese and Australian companies is described. On the second item the acceptance of purchasing goods from Japan and Australia and the condition of inspection and quality assurance to specific principal parts are described. On the third item the supplementary construction of the first stage, contents of constructions of the second stage are described. On the fourth item, preparation for operation, target, the whole circumstances and the results of maintenance, especially review of operation technique, training of operators, and occurrence and repair of troubles are described. As other relevant works, envirommental assessment, waste disposal, enviromental monitoring for exhaust gases, drainage and working enviroments, safety measure, educational training and moreover activities for local district people and the state of labor market as the support for execution of the project are described.

17596 (NP—8770046, pp 98-102) **Development and manufacture of equipment and material for plant. Development of a coal liquefaction reactor material.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

For the purpose of developing reactor material for a large scale liquefaction reactor to be operated under high temperature, high pressure and hydrogen environment, Evaluations were carried out as follows: (1) Evaluation of design criteria; Developed steel having alloy composition of low Si-3Cr-1 Mo-1/4V-Ti-B was selected to obtain data on 30,000 hrs creep rupture strength under high temperature above 450 'C. As a result, it was proved that the developed material satisfies the design allowable stress value in the standard of ASME code. (2) Evaluation of resistance to hydrogen attack; The test result of an autoclave test over 10,000 hrs showed that no deterioration in characteristics owing to hydrogen erosion of the development material was observed, even in the severe condition of 550 'C, 300kg/cm^2. Also it was confirmed that the material is low susceptiblity to hydrogen assisted cracking, high resistance to stainless steel overlay disboonding and excellent creep rupture characteriatics under high pressure hydrogen.

17597 (NP—8770046, pp 103-111) **Development and manufacture of equipment and material for plant. Development of material for auxiliary equipment of coal liquefaction plant; study by inplant test.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

A final annual report of a 5 year study on erosion and damage of material for auxiliary equipments of coal liquefaction plant. For the purpose to clarify the situation of erosion and damage of equipment and materials in various equipment parts of a coal liquefaction plant, a material test by means of inplant testing using a 2.4 t/d experimental plant was conducted. Furthermore, a study of anticorosion property centering on various kinds of material tests was carried out by an experimental plant of 1 t/d scale.(1) Study on inplant test: Tests of ordinary valves, check valves and piping for high pressure slurry were performed respectively. (2) Study of anticorrosion: Investigation of corrosion of test pieces, damage of plant piping and a container was made by inplant material test inside the 1 t/d experimental plant, while a basic test of corrosion of existing steel in liquefied slurry, produced gas and condensed liquid were conducted. As a result, it was made clear that 18 Cr-8 Ni series steel has high SCC sensibility and high alloy above 310 has low SCC sensibility. The above results is to be arranged together with the results of the study of material testing so far carried out since 1982 and will be reflected to the design of the 250 t/d pilot plant.

17598 (NP—8770046, pp 112-125) **Development and manufacture of equipment and material for plant. Development of hydrohoist for coal liquefaction; development of centrifugal slurry pump for liquefaction.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is the final annual report for the 5-year project concering the development of materials for a large scale reactor required in the commercialization of coal liquefaction process. Experiments have been carried out for the development of equipment of coal liquefaction plants and many basic design data have been accumulated. 1) Development of hydrohoist for coal liquefaction; As a result of test operations on a reliability test unit for 2,900 hours, the feed chamber, float, proximity switch, high pressure slurry vertical valve and pressure equalizer and controller therefor, have all been verified to be in satisfactory condition. 2) Development of centrifugal slurry pump; As a result of 2,000 hours trial run of a 14-stage slurry pump, using coal slurry, the wear loss of the volute vane was excessive, requiring modification of shape. Also relation between the wear of high pressure seal and flow rate were obtained and it was also determined that an impeller designed at the boss ratio 0.53 and above developed a lower head than expected.

17599 (NP—8770046, pp 126-135) **Investigation of coals for coal liquefaction.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This annual report for FY 1980 covers the study for coal selection for liquefaction. General properties and liquefaction characteristics of lignites, sub-bituminous coals and bituminous coals of principal coal-producing countries, particularly, Canada, Australia and the U.S.A., were investigated to establish a method of estimating the liquefaction coal supply potential of coal fields and the liquefaction coal selecting standards. The vertical and horizontal coal quality distribution in specified coal fields were investigated. The liquefaction characteristics (hydrogen consumption ratio, gas production, water production, oil yield, asphaltene yield, benzene conversion ratio) were measured through autoclaving using a batch autoclave (medium oil: freed anthracene, catalyst: iron sulfur, reaction temperature; 450 'C(420'C), reaction time: 60 min(120 min), temperature raising rate: 4 'C/min, initial hydrogen pressure: 100kg/cm^2). The liquefaction characteristics can be estimated through the determination of the rank of coalification and the composition of the coal. Although differences between kinds of coal, partial removal of inertinite by pretreatment improves the oil yield. The content of fine particles of vitrinite of low brightness influences the oil yield. The results of investigation of the stability

during transportation and storage, security of supply and procurement cost of coals produced in the eastern district of the U.S.A. and Australia are provided.

17600 (NP—8770046, pp 152-159) **Development and application of the estimation method for the coal-liquefaction process. Application of a liquefaction process simulator.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

In 1984, ALPS (Advanced Liquefaction Process Simulator) was completed. In 1985, ALPS has been used for the simulation of actual coal liquefaction process problems. On the development of the liquefaction of bituminous coal, this is the newly developed method in order to estimate and examine quantitatively the correlations between the whole process and the unit process. For ALPS to be operated effectively by users, the active supports were carried out as follows in the current year; (1) items about method of using ALPS program. (2) items about ALPS modeling parameters. (3) items about ALPS functional requirements. Moreover, for the purpose of adjusting those parameters being fitted for MEDOL process, preliminary examinations must be carried out about the correlations necessary to reflect NEDOL process data on the parameters of ALPS.

17601 (NP—8770046, pp 160-167) **Development of the enviromental protection, development of the waste water treatment technology.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

In order to establish the stable wastewater treatment technology for the coal liquefaction plant, the basic study was carried out in the fisical year 1981, 1982 and the laboratory equipment was made for the purpose of the development of the unit operation, which plays an important part of the plant and then, in the fiscal year 1983, on the basis of the results, operation studies were carried out to estimate the general quality of wastewater and the conventional treatment system in coal liquefaction plant was examined thoroughly in 1984. For purpose of the investigation on the total treatment system of coal liquefaction plant, in the current year, was carried out the analysis of water which is produced by the liquefaction reaction in It/d PDU and comparison of the values obtained from the liquefaction water samples from different coals. Moreover, to develop unit operations of effective wastewater treatment system, the following examinations were carried out; (1) phenol removal by solid-supported liquid membrance method. (2) decomposition of BOD by anaerobic fluidized bed. (3) decomposition of phenol by anaerobic bacteria. (4) removal of residual organic matters and S.S. by biofilter. (5) the total treatment system by non-biological method. Consequently many informations were obtained regarding the optimum total system. The studies finished at the fiscal year 1985. (6 tabs)

17602 **(NP—8770046) FY 1985 NEDO Annual Report.** (New Energy Development Organization, Tokyo (Japan)). Aug 1986. 1023p. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

Papers in the FY 1985 NEDO annual report have been entered individually into EDB and ERA. (LTN)

17603 **Influence of dispersion on the interactions of H_2 and CO with Pd/SiO_2.** Rieck, J.S.; Bell, A.T. (Lawrence Berkeley Lab., CA). *Journal of Catalysis;* **103**: No. 1, 46-54(Jan 1987). Contract AC03-76SF00098.

The influence of dispersion on the interactions of H_2 and CO with Pd/SiO_2 has been investigated. The distribution of H_2 adstates changes with dispersion, due possibly to a change in the morphology of the Pd crystallites or in the coordination of adsorbed H atoms with the Pd atoms. The ratio of linearly held CO to bridge-bonded CO decreases with the dispersion, as does the ratio of Pd(100) to Pd(111) planes on the surfaces of the Pd crystallites. CO dissociation occurs preferentially from bridge sites and proceeds more readily with decreasing dispersion. Consistent with this, the turn-over frequency for methanation increases with decreasing dispersion. 34 references.

17604 **Decomposition of decanol and decanal over Ni- and H-ZSM-5.** Riley, M.; Anthony, R.G. (Texas A & M Univ., College Station). *Journal of Catalysis;* **103**: No. 1, 87-94(Jan 1987). Contract FG22-82PC51261.

The decomposition of 1-decanol and decanal in the presence of hydrogen by using Ni- and H-ZSM-5 embedded within a silica binder was investigated. Temperatures and pressures for the decanol decomposition ranged from 572 to 666 K and 0.57 to 1.45 MPa, whereas for decanal the ranges were 622 to 722 K and 0.58 to 1.22 MPa. Decanol was converted to decene through the intermediate didecyl ether. Decanal was converted to nonane by the elimination of carbon monoxide; to a β-hydroxy carbonyl compound, an aldo, which subsequently dehydrated to yield C_{20} aldehyde. The aldehyde, subsequently, was converted to hydrocarbons. All of the above are acid-catalyzed reactions. A side reaction catalyzed by the reactor walls which occurred with both compounds was the hydrogenation of decanal or dehydrogenation of decanol. 6 references.

17605 **Effect of group IA cations on CO hydrogenation over Ru/Y-zeolites.** Oukaci, R.; Sayari, A.; Goodwin, J.G. Jr. (Univ. of Pittsburgh, PA). *Journal of Catalysis;* **102**: No. 1, 126-139(Nov 1986).

Previous results for zeolite-supported Ru prepared by ion-exchange suggested a possible effect of the nature and concentration of the neutralizing cations in the zeolite on the catalytic properties of the metal. The interpretation of these results were complicated by the fact that a series of zeolites with different Si/Al ratio was used. This paper reports the results of a study of a series of RuY catalysts prepared from NH_4Y, LiY, NaY, KY, RbY, and CsY zeolites. The nature of the group IA cations was found to have little effect on chemisorptive properties and on the activity and chain growth probability in CO hydrogenation on Ru. However, the nature of the cations produced changes in secondary reactions of primary olefinic products as a result of differences produced during catalyst preparation in Ru distribution in the zeolite crystallites and of possible modifications of the acid sites generated during reduction of the Ru. 57 references.

17606 **Studies of the interactions of H_2 and CO with Pd/SiO_2 promoted with Li, Na, K, Rb, and Cs.** Rieck, J.S.; Bell, A.T. (Lawrence Berkeley Lab., CA). *Journal of Catalysis;* **100**: No. 2, 305-321(Aug 1986). Contract AC03-76SF00098.

The interactions of CO and H_2 with Pd/SiO_2 promoted with Li, Na, K, Rb, and Cs have been investigated using temperature-programmed desorption and temperature-programmed surface reaction. Introduction of the promoter following the preparation of the Pd/SiO_2 catalyst causes a small increase (similarly ordered 7%) in the dispersion of the Pd particles. Reduction of the promoted catalysts removes a significant quantity of oxygen from the promoter, but only a small portion of the promoter appears to cover the Pd particles. Alkali promotion of Pd/SiO_2 does not significantly influence the amounts of H_2 and CO that can be adsorbed on the metal. The alkali promoters have a slight influence on the distribution of H_2 adstates but cause a significant change in the distribution of CO adstates. For low reduction temperatures, alkali promotion of Pd/SiO_2 decreases the activity of Pd for the dissociation of CO. However, increasing the reduction temperature increases the CO dissociation activity of the promoted samples due to the increased degree of reduction of the promoter. This enhanced dissociation activity is reversed by the reoxidation of the promoter by the H_2O or CO_2 formed under reaction conditions. The nascent carbon formed by CO dissociation on alkali-promoted Pd/SiO_2 is less reactive than that on unpromoted Pd/SiO_2, and the promoted catalysts have a lower activity for CH_4 synthesis relative to that for unpromoted Pd/SiO_2 decreasing in the order: unpromoted > Li > Na > K > Rb > Cs. 49 references.

17607 **Role of pH in the performance of precipitated iron Fischer-Tropsch catalysts.** Diffenbach, R.A.; Fauth, D.J. (Pittsburgh Energy Technology Center, PA). *Journal of Catalysis;* **100**: No. 2, 466-476(Aug 1986).

Precipitated iron Fischer-Tropsch catalysts were prepared at various constant pH levels with a Koelbel in-line mixing unit using either sodium carbonate or ammonium hydroxide as the precipitant.

In microreactor studies at 1.38 MPa and 548 K, the Na_2CO_3-precipitated catalysts prepared at low pH (3.7 and 4.7) showed unusually high olefin selectivity (C_2-C_4) as well as activity maintenance superior to that of the catalysts prepared at higher pH (5.8, 7.6, and 9.8). While the NH_4OH-precipitated catalyst showed lower olefin selectivity, the activities of these catalysts, especially the copper-promoted ones, were quite stable for periods of up to 300 h. Thermogravimetric studies indicated that graphitic carbon deposition occurred to a greater degree on Na_2CO_3-precipitated catalysts prepared at high pH. The high soda content of these catalysts was identified as one factor accounting for this deposition and presumably also accounted for the higher rates of deactivation. Those factors responsible for the high olefin selectivity of the Na_2CO_3-precipitated catalysts prepared at low pH remain unidentified.

0105 By-products

REFER ALSO TO CITATION(S) 17563, 17661

0106 Properties

REFER ALSO TO CITATION(S) 17407, 17411, 17412, 17414, 17458, 17461, 17464, 17498, 17499, 17510, 17525, 17532, 17547, 17566, 17567, 17569, 17570, 17571, 17572, 17575, 17599, 17661, 19084, 19256

17608 (DOE/METC—87/6079-Vol.1, pp 145-149) **Vaporization of trace inorganic species from coal under combustion and gasification conditions.** Hildenbrand, D.L.; Lau, K.H.; Lamoreaux, R.H.; Krishnan, G.N.; Brittain, R.D. (SRI International, Menlo Park, CA). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objective of this project is to establish the chemical forms and relative abundances of trace inorganic species in coal during combustion and gasification. Knowledge of the chemical species involved in trace element transport will be useful in designing strategies for removal of species with negative impacts on various coal use technologies. Knudsen cell mass spectrometry and Gibbs energy minimization calculations are being used to study the vaporization of two representative US coals: Illinois No.6 bituminous and Wyodak subbituminous. Vapor species are identified, and their abundances measured, over the temperature range 300-1700 K. In the first year of the program, vaporization from the coal ash alone is being studied; in the second year, the influence of added oxidizing and reducing gas mixtures on trace element vaporization will be investigated. Gibbs energy minimization calculations are being performed to simulate the conditions of the mass spectrometry experiments. The approach is interactive: species seen in mass spectrometry experiments are added to the data base for calculations, and predicted species from calculations are searched for in the experiments. After reasonable agreement has been reached between the results of the two approaches, calculations during the second year of the program will be extended to the higher pressure conditions existing during actual coal gasification and combustion. The results of the latter calculations will be used to evaluate proposed strategies for the removal of trace elements which have deleterious technological or environmental effects.

17609 (DOE/PC/60811—T2) **The mobile phase in coals: Its nature and modes of release: Part 2, Efforts to better define the nature and magnitude of the mobile phase: Final report.** Given, P.H. (Pennsylvania State Univ., University Park (USA). Coal Research Section). Apr 1987. Contract FG22-83PC60811. 47p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE87009066/JAW.

Several liquefaction conditions and many extracting solvents were used in attempts to set up conditions such that, as the conditions became more severe, progressively more hexane-solubles, analyzable by GC/MS, would be released. It was hoped to identify a threshold beyond which trapped mobile phase molecules would become evident. A set of 10 hexane-soluble fractions, all obtained under various conditions from the same coal (a sample of Herrin No. 6 seam, Illinois), were subjected to analysis by tandem mass spectrometry (MS/MS). Yields ranged from 0.6 to 16% of the organic matter in the coal. Prominent constituents of all of the fractions were homologous series of alkyl aromatic hydrocarbons, phenols and heterocycles, notably alkylacenaphthenes. Alkyl chains were either unbranched or lightly branched. There was a similarity in the spectra of all of the fractions irrespective of yield. The ease with which a certain homologous series can be released from a coal is highly variable. Thus the data are consistent with the concept of a mobile phase some components of which are trapped in cavities with entrances and exits of restricted size. Release of the various physically held species and the fragments from thermal breakdown of the structure will certainly present a very complex system for kinetic modeling. 30 refs., 10 tabs.

17610 (DOE/PC/70799—T12) **Identification of nonvolatile coal derived products via chromatography coupled with on-line FTIR detection: Quarterly progress report for the period June 1, 1987-August 31, 1987.** Taylor, L.T. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Jan 1988. Contract FG22-84PC70799. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004454/JAW.

The analysis of nonvolatile coal-derived liquefaction products for minor and trace components which contain nitrogen, oxygen or sulfur presents unique challenges. Justification for their analysis rests on the premise that heteroatom-containing materials can aid and/or hinder the conversion process. This proposal builds upon our efforts during the initial three year grant period regarding the interfacing of Fourier transform infrared spectrometry with size exclusion and normal phase chromatography for the analysis of coal-derived products. Four objectives are proposed: (1) optimize the HPLC-FTIR interface in terms of detectability, identifiability and chromatography, (2) extend the HPLC-FTIR approach to reversed phase chromatography wherein more efficient separations are possible for heteroatom species, (3) determine the feasibility of interfacing supercritical fluid chromatography with FTIR for the analysis of coal-derived products and (4) employ hyphenated methods to ascertain on a molecular level the changes that occur in a nonvolatile coal derived product when various liquefaction parameters are varied. From the results with a crosslinked propyl cyano column, the cross-linking of the surface of bonded phases could be a step toward the further advancement of packed columns for both SFC and HPLC. Also, other types of crosslinked packed columns (C/sub 18, C/sub 8/, C/sub 1/, NH/sub 2/, phenyl and polyethylene glycol) are currently under preparation and evaluation.

17611 (DOE/PC/79917—T1) **NMR investigation of supported metal catalysts for syngas conversion: First quarterly technical progress report 1, September 15, 1987-September 14, 1989.** Murty, A.N. (Grambling State Univ., LA (USA)). 1 Feb 1988. Contract FG22-87PC79917. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005352/JAW.

This report describes the work carried out on the NMR project on supported metal catalysts. The primary objective of the project is a detailed investigation of the metal-support, metal-promoter, and metal-adsorbate interactions. We except any significant interaction between cobalt and the support is likely to alter the magnetic characteristics of the cobalt metal. As such, the Zero-field NMR Spectra and the magnetic susceptibility measurements should be able to detect the changes in the magnetic character of cobalt metal.

17612 (DOE/PC/79930—T1) **Pyrolysis and gasification of coal at high temperatures: Quarterly progress report No. 1, September 15-December 15, 1987.** Zygourakis, K. (Rice Univ., Houston, TX (USA). Dept. of Chemical Engineering). 1987. Contract FG22-87PC79930. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004011/JAW.

Research continued in three areas: (1) Effects of pyrolysis conditions on macropore structure - Coals of different ranks were pyrolyzed. The macropore structure of the produced chars were characterized using video microscopy and digital image processing techniques to obtain pore size distributions. The effect of pyrolysis conditions on the pore structure of the devolatilized chars will be

evaluated; (2) Gasification under strong intraparticle diffusional limitations - The devolatilized chars will be gasified in the regime of strong intraparticle diffusional limitations using O_2/N_2 and $O_2/H_2O/N_2$ mixtures. Additional gasification experiments performed in the hot-stage reactor will be videotaped and selected images will be analyzed to obtain quantitative data on particle shrinkage and fragmentation; and (3) Mathematical modeling and model validation - Discrete mathematical models will be developed and validated using the experimental gasification data. Structural properties of the unreacted chars will be used to generate computational grids simulating the pore structure of the solid. Simulations will then provide the evolution of observed reaction rates with conversion. 14 figs., 1 tab.

17613 **(DOE/PC/80517—T9) Improving the stability of coal slurries: Quarterly progress report for the period September 15, 1987-December 15, 1987.** Fogler, H.S. (Michigan Univ., Ann Arbor (USA). Dept. of Chemical Engineering). 1987. Contract FG22-85PC80517. 14p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88003861/JAW.

Gum tragacanth, GT changes the conformation on the negative surface of sulfate polystyrene latex particles as the amount of charge in GT alters with pH. Also, it had been indicated that the polygalacturonic acid, PGUA which constitutes the core of GT molecules is responsible for the conformational change. In order to find how this conformational change is related to the adsorption affinity between the surface and the polyelectrolyte, the positively charged amidine polystyrene latex particles were employed. The stability study showed that the PGUA can also stabilize the positively charged particles and that the stability of the amidine latex is virtually independent of pH whereas the stability of the sulfate latex is dependent on pH. The adsorption study indicated that this independence of stability on pH for the amidine latex is due to the fact that the strong adsorption affinity between the positive surface and the negative polyelectrolyte gives the similar conformation regardless of pH. 6 refs., 8 figs., 2 tabs.

17614 **(DOE/PC/80529—T7) Effects of coal structure on pulverized coal combustion processes: Quarterly technical progress report No. 9 for the period 1 October 1987 to 31 December 1987.** Wells, W.F.; Smoot, L.D. (Brigham Young Univ., Provo, UT (USA). Combustion Lab.). 15 Jan 1988. Contract FG22-85PC80529. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005165/JAW.

Three very different coals (lignite, subbituminous, and bituminous will be processed to prove the following components: (1) organic material extractable from coal by pyridine extraction, (2) the solid residue from this extraction process, and (3) char remaining after a high temperature devolatilization of the virgin coal. The coals and their derived solids will be reacted with air at high temperatures (1300, 1500, and 1700 K) to obtain reactivity data. The reactivity data will then be examined for relationships with the physical and chemical properties. 10 refs.

17615 **(DOE/PC/80907—T8) Reactivity of coal in direct hydrogenation processes: Technical progress report, September-November 1987.** Baldwin, R.M.; Miller, R.L. (Colorado School of Mines, Golden (USA). Dept. of Chemical Engineering and Petroleum Refining). 1987. Contract FG22-85PC80907. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005285/JAW.

Research focused on two facets of the reactivity studies. First, a series of experimental runs aimed at investigation of the role of hydrogen in direct liquefaction were completed. A model compound system consisting of dibenzyl in aromatic (non-donor) or hydroaromatic (hydrogen donor) vehicles was hydrogenated to determine the effect of molecular hydrogen and hydrogen from donor molecules in the radical quenching and bond scission reactions. Special attention was paid to the role of hydrogen as an active bond cleavage agent. These data show the relative participation of hydrogen from both sources at conditions relevant to the reactivity data and provide support for the role of hydrogen acting directly to promote bond cleavage. Maintenance of a "pool" of hydrogen atoms was found to be of great importance in terms of promoting hydrogenolysis and hydrocracking reactions of dibenzyl. Five bituminous coals from the Argonne premium coal collection were liquefied at conditions similar to those employed in the model compound study. The general findings relative to the activity of molecular hydrogen determined from the model compound experiments were evidenced in the coal liquefaction data. Additionally, the presence of aliphatic hydrodgen in the coal itself was found to be a highly significant factor in determining the sensitivity of coal conversion to the presence of gas phase molecular hydrogen. 8 refs., 6 figs., 8 tabs.

17616 **(DOE/PC/90504—T4) Configurational diffusion of coal macromolecules: Quarterly progress report, September 15, 1987-December 15, 1987.** Guin, J.A.; Curtis, C.W.; Tarrer, A.R. (Auburn Univ., AL (USA). Coal Conversion Lab.). 1987. Contract FG22-86PC90504. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004535/JAW.

The objective was to investigate the phenomena of hindered diffusion of coal macromolecules in idealized porous media. Towards this, ideal membranes of Nuclepore and alumina were constructed and characterized. Average pore diameter was determined by permeability tests with fluid (water and xylene) and gas. Flow rates were measured. Diffusion experimental data were then analyzed to evaluate the boundary layer resistance. 9 refs., 4 figs., 3 tabs. (CS)

17617 **(DOE/PC/90507—T5) Surface properties of coal and their role in coal beneficiation: Technical progress report, 15 September, 1987-14 December 1987.** Fuerstenau, D.W. (California Univ., Berkeley (USA). Coll. of Engineering). Jan 1988. Contract FG22-86PC90507. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004676/JAW.

The overall objective of this research program is to delineate the wetting behavior of coal and the effect this behavior has on fine coal processing techniques. Our previous report discussed our investigtion of the FTIR Spectroscopy of oxidized coal surfaces. Changes in the functional groups residing at the coal surface due to various oxidizing treatments were monitored. In order to understand the oxidation process of coal more fully and its effect on further processing, research this past quarter has focused on chemical oxidation of coal by hydrogen peroxide. The critical surface wetting tension was determined and the results correlated with the acidic oxygen content of the oxidized coals. This report also details a study of the induction time of coals and its relation with kinetics of flotation. 5 refs., 6 figs.

17618 **(DOE/PC/90913—T4) Biochemical bond breaking in coal: Fifth quarterly report, [October 1, 1987 through December 31, 1987].** (ARCTECH, Inc., Alexandria, VA (USA)). Jan 1988. Contract FG22-86PC90913. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004949/JAW.

The goal of this program is to provide a basic understanding of the biochemical mechanisms by which natural microorganisms solubilize low-rank coals. The major objectives are to: (1) optimize coal biosolubilization; (2) characterize the solubilized products resulting from coal depolymerization; and (3) assess potential interunit linkages which may be attacked by whole cultures or cell-free culture supernatants containing the depolymerizing system through detailed model compound studies. 7 figs., 3 tabs.

17619 **(DOE/PC/91565—2) Automated microscopy methods for measuring pyritic sulfur content of coal and determining degree of liberation of pyrite in coal: Final report.** Chaparro, L.F. (Pittsburgh Univ., PA (USA). Dept. of Electrical Engineering). 25 Jul 1987. Contract FG22-86PC91565. 66p. NTIS, PC A04. Order Number DE87012690/JAW.

The objective of this project is to develop an automated procedure, to be implemented in an IBAS image analyzer, to determine size, shape and degree of liberation of pyrite particles in a coal matrix. This procedure is to work in real time conditions and with minimal intervention from the operator. Our approach is to create from the original microscopic image a three level image with the following components: epoxy, coal macerals and pyrite to simplify the calculations. Enhancing the original image by histogram

scaling and median filtering, we segment it and form the three level image. After the boundaries of the pyrite particles are defined, we mask the surroundings of the particle to estimate the degree of liberation. The percentage of epoxy included in the mask is defined as the degree of liberation of the particle. Size and shape factor values are simultaneously calculated for each of the analyzed particles. These particles are classified according to their maximum diameter, shape factor and degree of liberation by the program. 6 refs., 18 figs.

17620 **(EPRI-AP—5343-SR, pp 15.1-15.30) Slurryability as a function of coal properties.** Butcher, T.; Sapienza, R.S.; Krishna, C.R.; O'Hare, T.E.; Saunders, J.; Celebi, Y. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920087/JAW. (CONF-8610351—).

From 6. annual EPRI contractors' conference on coal gasification; Palo Alto, CA, USA (15 Oct 1986).

The efficiency and economics of integrated gasification/combined cycle plants with slurry fed gasifiers are enhanced by high slurry coal concentrations. This paper reports on a recently completed study of the slurryability of candidate gasifier coals, loading limits, and slurry formulation options for use in systems of this type. The ten candidate coals studied ranged in equilibrium moisture from 1 to 13%. The set included Pittsburgh No.8 seam coals, Illinois, No.6 seam coals, and one Utah coal. For three of the coals both run of mine and preparation plant product were examined. Coal characterization included standard analyses, relative hydrophilic/hydrophobic nature, surface area, density, surfactant adsorption, and leachable ions. A ranking was made of the relative slurryability of the coals under two cases, with and without an added surfactant. The ranking was based on apparent viscosity at 100 sec^{-1}, and was somewhat different in the two cases. As others have reported, equilibrium moisture is a key parameter. Slurry formulation studies included the effects of size distribution, acid leaching, additional physical cleaning-both gravity separation and froth floatation, selected anionic and nonionic surfactants, pH, and oxidation to simulate weathering. The study has recommended that significant loading increases could be achieved using low concentrations of surfactants alone. This is particularly true for the higher rank coals, which have lower additive demand, and have a greater viscosity reduction at the optimum additive concentration. 14 references, 18 figures, 16 tables.

17621 **(EPRI-CS—5421) Coal quality information book: Interim report.** Parkinson, J.W.; Suardini, P.J.; Cavalet, J.R. (Kaiser (Raymond) Engineers, Inc., Homer City, PA (USA); Science Applications International Corp., Homer City, PA (USA)). Dec 1987. 491p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920107/JAW.

The Coal-Quality Information Book presents physical and chemical properties of selected utility coals from throughout North America depicting each coal's cleanability and combustion characteristics. Size distribution and washability analyses define the physical characteristics important for coal cleaning and handling. ASTM analyses, such as proximate and ultimate analyses and ash fusibility and ash constituent analyses, convey the chemical characteristics important for coal combustion. The data are presented in a form specifically designed to be used by the electric utility industry for specifying, purchasing, and cleaning coals for steam generators. Quantitative data are included for each raw coal cleaned to one or more quality levels using full-scale coal-cleaning circuitry. This unique full-scale comparative data, which has not been available in the past, allows utilities to specify the level of coal-quality from a mine that results in the lowest power generation costs. The book contains data for 20 raw coals and 50 clean coals produced from the raw coals. There are 17 bituminous and subbituminous ranked coals, two lignites, and one anthracite culm (refuse) from seven states and two Canadian provinces. All of these coals were characterized at the Electric Power Research Institute's (EPRI) Coal Quality Development Center (CQDC) near Homer City, Pennsylvania. This is the first in a series of coal-quality information books that EPRI plans to publish containing quality and cleanability data. Future issues will contain additional information from the CQDC, information collected from the public domain, and information contributed by electric utilities and other organizations from across the US. A companion computerized version of this information called the Coal-Quality Information System, which operates on a personal computer, is scheduled to be available from EPRI in 1988.

17622 **(EPRI-CS—5523-Vol.1) Slagging and fouling in pulverized-coal-fired utility boilers: Volume 1, A survey and analysis of utility data: Final report.** Barrett, R.E.; Tuckfield, R.C.; Thomas, R.E. (Battelle Columbus Div., OH (USA)). Dec 1987. 364p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920131/JAW.

A survey was conducted among utilities to collect data on boiler features, coals fired, operating parameters, and the frequency and nature of slagging and fouling problems. Data were supplied by forty-eight US utilities on 120 units. The data were analyzed using descriptive statistics, multivariate discriminant analyses, and graphical analyses to determine the boiler, coal, and/or operating parameters that most closely correlated with the frequency of slagging and/or fouling problems. Results for various combinations of parameters are tabulated. Those giving the best classifications of units in the data base are shown graphically. 12 refs., 34 figs., 58 tabs.

17623 **(EPRI-CS—5523-Vol.2) Slagging and fouling in pulverized-coal-fired utility boilers: Volume 2, A survey of boiler design practices for avoiding slagging and fouling: Final report.** Barrett, R.E. (Battelle Columbus Div., OH (USA)). Dec 1987. 161p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920132/JAW.

A survey was conducted of four utility boiler manufacturers to obtain nonproprietary information regarding criteria that they use for designing boilers to avoid slagging and fouling. A portion of the survey identified boiler design features that are influenced by coal properties. Survey results were used to identify (1) the boiler features that manufacturers consider important when designing to avoid slagging and fouling, and (2) the coal parameters that are used in determining values for the critical boiler design features. Another part of the survey was used to obtain design information for a series of 500-MW boilers intended to fire each of six coals with varying slagging and fouling tendencies. The results were compared to identify how each manufacturer alters boiler designs to compensate for firing coals with greater slagging and fouling tendencies. It was found that each boiler manufacturer judges a different one of the six coals to present more serious deposit problems. The results suggest that each manufacturer uses different coal criteria for designing boilers. A surprising result was that some of the design furnace exit gas temperatures (which were frequently cited as important design criteria) exceed the ash fusion temperatures of several of the coals; a situation presenting a potential for deposits to form on the first few rows of convection tubes. 17 refs., 35 figs., 13 tabs.

17624 **(EPRI-ER—5474) Depolymerization mechanism of model coal linkages: Final report.** Fish, R. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 30p. NTIS, PC A03/MF A01 - RRC, Box 50490, Palo Alto, CA 94303; 1; GPO Dep. Order Number DE88004265/JAW.

Depolymerization of coal, by the use of chemical reducing agents such as alkali metals in amine or ether solvents as well as in the presence of the alkali cation binding crown ethers, has resulted in considerable speculation concerning the reactivity of coal linkages. The objective of this project is to develop a fundamental understanding of the mechanistic chemistry associated with aromatic esters and ethers, which are models for several coal linkages, in their reactions with solvated electrons. Results show that aromatic esters, substituted with methoxyl and hydroxyl groups, react upon mixing with the electron-transfer reagent K metal / 18-Crown-6 / THF, at 0°C. The methoxy substituted ethers, which were slower than the corresponding esters, did not show any pronounced rate differences when compared to the standard, diphenyl ether. The regioselectivity for C-O bond-cleavage was found to be at the carbonyl-oxygen bond for all the aromatic esters studied. The 4-substituted aromatic ether cleavage reactions led to the 4-substituted phenols; however, the exception was the 2-methoxyphenyl phenyl ether, which provided phenol. The effect of the substituents on the relative rate of C-O bond-cleavage for the aromatic esters and

ethers was briefly studied by a qualitative Hammett treatment. 24 refs., 4 figs., 2 tabs.

17625 **(NIPER—271) The thermodynamic properties of organic oxygen compounds: Topical report.** Chirico, R.D.; Steele, W.V.; Hossenlopp, A.; Nguyen, A.; Archer, D.G.; Strube, M.M. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Jan 1988. Contract FC22-83FE60149. 24p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88001208/JAW.

The principles of group additivity are used to compare a series of cyclic hydrocarbons with the corresponding oxygen-containing analogues. The strengths and limitations of the group-additivity method are demonstrated and recommendations are made for measurements essential to the improvement of the accuracy of the predicted properties. The ideal-gas enthalpies of formation and ideal-gas entropies (which are used in combination to calculate Gibbs energies) are considered. 35 refs., 3 tabs.

17626 **Macromolecular structure of coals.** Lucht, L.M.; Peppas, N.A. (Lawrence Livermore National Laboratory, CA (USA)). *Erdoel und Kohle, Erdgas, Petrochemie vereinigt mit Brennstoff-Chemie;* **40**: No. 11, 483-485(Nov 1987). (In English).

Equilibrium swelling studies at 35 degrees C and 60 degrees C in various solvents, including alcohols and ketones, were performed for a wide range of coal samples. Correlations were established between the equilibrium degree of swelling (Q) and the carbon content of the coal samples. The level of swelling was explained with respect to the solvent solubility characteristics. These results may be important in the analysis of the macromolecular structure of bituminous coal. 25 refs., 2 figs., 2 tabs.

17627 **The eight coals in the Argonne Premium Coal Sample Program.** Vorres, K.S. (Chemistry Div., Building 211, Argonne National Lab., Argonne, IL 60439). pp 160-165 of Proceedings of the 4th annual Pittsburgh coal conference. Greensburg, PA; MEMS (1987). (CONF-870942—).

From 4. annual Pittsburgh coal conference; Pittsburgh, PA, USA (28 Sep 1987).

The full set of eight coals for the Premium Coal Sample Program includes a lignite, subbituminous, high volatile, medium volatile and low volatile bituminous, as well as a liptinite rich, an inertinite rich and a Pittsburgh #8 coking coal. The coals were selected on the basis of C, H, S and O content as well as maceral content and geological age. Ampoules are typically available in 5 grams of -100 mesh or 10 grams of -20 mesh material. Some analytical information is available. The methods of selection, collection, transportation, processing, packaging, distribution and characterization are summarized. More than 70 laboratories are participating in the analysis. Over 115 shipments have been made to more than 50 different organizations for a range of programs in basic coal research.

0108 Waste Management

REFER ALSO TO CITATION(S) 17431, 17435, 17438, 17481, 17482, 17483, 17490, 17531, 17578, 17601, 17643, 17662, 18137, 18139, 18141, 18142, 18143, 18145, 18146, 18147, 18148, 18151, 18153, 18154, 18700, 18721

17628 (DOE/METC—87/6079-Vol.1, pp 251-261) **Performance evaluation of a screenless (counter-current) granular bed filter on a subpilot-scale PFBC.** Wilson, C.; Cooper, J.; Placer, F. (Combustion Power Co., Menlo Park, CA). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objectives of this investigation are: (1) to augment information on the feasibility of a Granular Bed Filter (GBF) for controlling particulate in a Pressurized Fluidized-Bed Combustor (PFBC) power generating system, (2) to assess the design and life of critical components in the filter system, and (3) to estimate costs of a commercial-scale design based on tested concepts. Equipment and test facilities are described. Parametric tests which compared measurements and theoretical media circulation rates have been completed. Other tests observed the ash carrying capability of the media, the operation of the ash discharge system, and the characteristics of operation with larger media. Results are discussed. 6 references, 7 figures.

17629 (DOE/METC—87/6079-Vol.1, pp 262-269) **Testing of electrostatic precipitator at New York University.** Kumar, K.S.; Feldman, P.L. (Cottrell Environmental Sciences, Somerville, NJ). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1). Contract AC21-84MC21094.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The electrostatic precipitator testing and evaluation program at New York University's PFBC test facility was initiated in November 1986. The objective was to determine its particulate collection efficiency at the combined cycle PFBC exhaust conditions of 1650°F and 10 atmospheres. The nominal gas flow to ESP at these conditions was typically 1200 acfm. The electrostatic precipitator was of the horizontal flow plate type such as that used in conventional utility power plants. Equipment and tests are described, results are discussed, and recommendations are given for design modifications.

17630 (DOE/METC—87/6079-Vol.1, pp 299-307) **Advanced wastewater treatment.** Gallagher, J.R.; Turner, C.D. (Univ. of North Dakota, Grand Forks). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The principal objective is to expand the scientific and engineering data base on the treatment of gasification wastewater. Efforts are focused on novel methods to achieve the following: (1) combined carbon oxidation/nitrogen removal, and (2) a high-rate biological oxidation reactor. A third effort will examine pretreatment requirements for the discharge of gasification effluents to publicly-owned treatment works. To date work has focused on biological fluidized bed treatment of gasification wastewater. The wastewater used for this research is stripped gas liquor (SGL) from the Great Plains Gasification Plant near Beulah, North Dakota. Bench scale tests using the conventional upflow fluidization mode, with sand as the media, has demonstrated the applicability of the coupled process for combined carbon and nitrogen removal from SGL. A second bench scale coupled reactor tested a modified fluidization technique. The media used was low specific gravity spheres. Fluidization was achieved by adding the wastewater at the top of the bed, with the media fluidizing downwards. This fluidization method requires less recycle to maintain fluidization than the conventional upflow mode, resulting in energy savings. A process development unit has been constructed in the downflow mode for further testing and development of process performance and kinetic data. Results of these tests are discussed. 4 references, 6 figures, 1 table.

17631 (DOE/METC—87/6079-Vol.2, pp 614-618) **Throwaway processes for treatment of regeneration tail gases.** Bodek, I.; Woodland, L.R. (Arthur D. Little, Inc., Cambridge, MA). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The goal of this program is to evaluate processes for treating the regeneration tail gas from a high-temperature desulfurization process (zinc-ferrite process) used in coal gasification applications. METC has sponsored the development of an elemental sulfur recovery process which has proven to be technically practical, but appears economically unattractive. The primary objective of this test program is the demonstration on a bench-scale of an energy-efficient, non-recovery process that can treat this offgas stream, while producing environmentally acceptable waste products. A second objective of this test program is to collect sufficient data to allow incorporation of the test results into a conceptual full-scale design for comparing the economics of the non-recovery processes with the recovery processes under development. The two flue gas desulfurization process concepts which will be investigated in the

bench-scale test program are the spray drying and dual-alkali processes. Although these two technologies have already been demonstrated on commercial and/or pilot plant scale for coal-fired generating stations, they are presently operated under much different conditions than required for this application. They are normally used for much lower sulfur dioxide concentrations; and in most cases, at lower temperatures and atmospheric pressure. Test facilities have been constructed and testing is in its initial stages.

17632 (DOE/METC—87/6079-Vol.2, pp 619-623) **Sorbent-based recovery of sulfur from regeneration tail gases.** Harkins, S.M.; Gangwal, S.K. (Research Triangle Institute, Research Triangle Park, NC). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

This project is to develop a process for the conversion of hot gas desulfurization off-gases containing approximately 1% SO_2 to a suitable Claus plant inlet gas containing 10 to 50% H_2S at high pressure and temperature. The process will employ a regenerable alkali metal based sorbent with appropriate structural integrity, reactivity, capacity, and mechanical strength. Samples of the proposed alkali metal-based sorbent were prepared very early in the program, and these were tested in a bench-scale apparatus to demonstrate that the process was worthy of further investigation. The possible reactions between the sorbent during sulfidation and regeneration were thermodynamically studied to both verify process feasibility and to examine possible thermodynamic limitations of the process. Current research is focusing on the development of a superior sorbent with suitable properties for use in the process. After producing a successful base sorbent, variations of the base sorbent procedure are being examined to produce a sorbent which is best suited to the process. The reactivity, capacity, and structural integrity of several sorbent variations will be examined, and the most suitable sorbent selected for further testing. Results from testing as Na/Al sorbent are briefly discussed.

17633 (DOE/METC—87/6079-Vol.2, pp 656-667) **Sulfur recovery from hot coal gas desulfurization processes.** O'Hara, J.B.; Chow, T.K.; Findley, J.E. (Ralph M. Parsons Co., Pasadena, CA). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2). Contract AC21-84MC21097.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The project objective was to define the preferred technology and projected economics for recovery of salable elemental sulfur, in an environmentally acceptable manner, from regeneration offgases produced in hot coal gas desulfurization processes. Major project tasks included preferred process selection, experimental testing, conceptual designs and economic evaluation. The results of each of these activities are described. The Beavon Sulfur Removal Stretford process and the Augmented Claus process were the preferred technologies. 2 references, 5 figures, 8 tables.

17634 (DOE/OR/21400—H4-Vol.1) **Utility FGD [flue gas desulfurization] survey, January-December 1985: Volume 1, Categorical summaries of FGD systems.** Melia, M.T.; McKibben, R.S.; Jones, F.M. (PEI Associates, Inc., Cincinnati, OH (USA)). Apr 1987. Contract AC05-84OR21400. 458p. NTIS, PC A20/MF A01; 1; GPO Dep. Order Number DE88003279/JAW.

The Utility FGD Survey report, whcih is generted by a computerized data base system, represents a survey of operational and planned domestic utility flue gas desulfurization (FGD) systems. It summarizes information contributed by the utility industry, system and equipment suppliers, systems designers, research organizations, and regulatory agencies. The data cover system design, fuel characteristics, operating history, and actual system performance. Also included is a unit-by-unit discussion of problems and solutions associated with the boilers, scrubbers, and FGD systems. The development status (operational, under construction, or in the planning stages), system supplier, process, waste disposal practice, and regulatory class are tabulated alphabetically by utility company. Simplified process flow diagram of FGD systems, definitions, and a glossary of terms are attached to the report. Current data for domestic FGD systems show 135 systems in operation, 15 systems under construction, and 56 systems planned. The current FGD-controlled capacity in the United States is 57,899 MW. This report, Volume 1, provides summaries of domestic FGD systems. 3 figs., 7 tabs.

17635 (DOE/OR/21400—H4-Vol.2-Pt.2) **Utility FGD [flue gas desulfurization] survey, January-December 1985: Volume 2, Design performance data for operating FGD systems: (Part 2 of 2).** Melia, M.T.; McKibben, R.S.; Jones, F.M. (PEI Associates, Inc., Cincinnati, OH (USA)). Apr 1987. Contract AC05-84OR21400. 753p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE88003281/JAW.

The Utility FGD Survey report, which is generated by a computerized data base system, represents a survey of operational and planned domestic utility flue gas desulfurization (FGD) systems. It sumarizes information contributed by the utility industry, system and equipment suppliers, system designers, research organizations, and regulatory agencies. The data cover system design, fuel characteristics, operating history, and actual system performance. Also included is a unit-by-unit discussion of problems and solutions associated with the boilers, scrubbers, and FGD systems. The development status (operational, under construction, or in the planning stages), system supplier, process waste disposal practice, and regulatory class are tabulated alphabetically by utility company. Simplified process flow diagrams of FGD systems, definitions, and a glossary of terms are attached to the report. Current data for domestic FGD systems show 135 systems in operation, 15 systems under construction, and 56 systems planned. The current FGD-controlled capacity in the United States is 57,899 MW. This report, Volume II Part 2, provides design and performance data for domestic FGD systems alphabetically M (Monogahela) thru W (West Penn Power).

17636 **(DOE/PC/80512—T13) Anaerobic SBR treatment of coal conversion wastewaters: Eighth quarterly report.** Ketchum, L.H. Jr. (Notre Dame Univ., IN (USA). Dept. of Civil Engineering). 11 Dec 1987. Contract FG22-85PC80512. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003677/JAW.

Results are presented for anaerobic biodegradation of constituents of coal conversion wastewater. Biochemical Methane Potential tests were employed. The relative toxicity of each constituent on anaerobic phenol degradation was also tested. Methylated phenols tended to be more inhibitory to phenol degradation than other hydroxylated and nitrogen containing aromatics. Studies of reaction intermediates of degradation are underway. Several intermediates have been identified in the degradation of p-cresol. 1 fig., 2 tabs. (CBS)

17637 **(DOE/PC/80512—T14) Anaerobic SBR treatment of coal conversion wastewaters: Ninth quarterly report.** Ketchum, L.H. Jr. (Notre Dame Univ., IN (USA). Dept. of Civil Engineering). 18 Feb 1988. Contract FG22-85PC80512. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005900/JAW.

The effect of initial seed sludge concentration on the toxicity of cyanide and 3,4-dimethyl phenol (3,4 DMP) to phenol degradation is currently being tested in 150 mL serum bottles. The procedures followed in this study are similar to those previously described for other completed ATA's. However, instead of using one initial seed sludge concentration, four different concentrations are being tested for each test toxicant concentration. Preliminary results indicate that inhibition of phenol degradation by cyanide is strongly dependent on the initial seed sludge concentration. The lower the initial seed sludge concentrations are inhibited by lower cyanide concentrations. However, inhibition caused by 3,4 DMP appears to be independent of initial seed sludge concentration, with the degree or extent of inhibition almost identical at all MLVSS concentrations. 1 tab.

17638 (EPRI-AP—5343-SR, pp 18.1-18.33) **Treatment studies on coal gasification waste waters.** Zeien, C.T.; Peterson, D.L.; Mayer, G.G.; Moe, T.A.; Turner, C.D.; Wentz, C.A. (Univ. of North Dakota, Grand Forks). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920087/JAW. (CONF-8610351—).

From 6. annual EPRI contractors' conference on coal gasification; Palo Alto, CA, USA (15 Oct 1986).

This paper describes the recent work on a study sponsored by the Electric Power Research Institute to assess the treatment of waste waters generated from the use of coal gasification for integrated-gasification-combined-cycle (IGCC) power generation. The project includes engineering and economic evaluations as well as bench-scale treatability testing for process design verification. The study focuses on three gasification processes: KILnGAS air-blown, rotary kiln gasifier; Texaco oxygen-blown, coal/water slurry, entrained bed gasifier; and BGC-Lurgi oxygen-blown, slagging, moving bed gasifier. The study will culminate in the preparation of a manual for use by the utility industry on waste water treatment for IGCC power plants. This paper summarizes the results of treatability testing of the KILnGAS and Texaco waste waters collected from the demonstration commercial-scale gasifiers in East Alton, Illinois, and Dagget, California, respectively. Testing of the BGC/Lurgi waste water is slated to begin in March 1987. 8 references, 5 figures, 16 tables.

17639 (EPRI-AP—5343-SR, pp 19.1-19.17) **Evaluation of gasification slag utilization potential.** Choudhry, V.; Deason, D.M.; Sehgal, R.S. (Praxis Engineers, Inc., Milpitas, CA). Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920087/JAW. (CONF-8610351—).

From 6. annual EPRI contractors' conference on coal gasification; Palo Alto, CA, USA (15 Oct 1986).

Coal conversion processes, such as gasification, produce waste materials which can represent a significant expense in disposal costs to the utility. For some time now, fly ash, bottom ash, and boiler slag from combustion systems have been increasingly utilized in construction and other applications. However, very little evaluation has been carried out to date on coal conversion waste materials. This paper describes the results of an EPRI-sponsored study investigating the utilization potential of gasifier slag produced by the Cool Water IGCC facility, located in Daggett, California. This study included evaluation of the applicability of the slag to road and other construction, as well as general characterization of the material. The slag has been found to possess properties which distinguish it from both conventional materials and other coal-related wastes. The preliminary results of this characterization work are very encouraging, indicating the need for further study of the properties and possible applications of coal conversion wastes. 12 references, 1 figure, 5 tables.

17640 **(PB—88-129333/XAB) Returning coal waste underground. Final report, September 29, 1981-March 30, 1986. Open file report.** Popovich, J.M.; Adam, R.F.J. (Ketron, Inc., Pittsburgh, PA (USA)). Jul 1986. 269p. NTIS, PC A12/MF A01.

See also DE82-014541.

This report describes a system designed to return coal mine waste to the operating underground mine generating it. The system, which was installed and tested at a site operated by the Millers Cove Energy Company, Inc. in Lee County, VA, limits the size of the surface facilities and incorporates state-of-the-art hydraulic transport and backfilling technology and equipment to systematically backfill areas in the active mine. The cost of returning coal waste underground at the Millers Cove site was estimated at $0.67 per ton of marketable coal (1982 dollars), which is slightly higher than their surface disposal cost of $0.61 per ton of marketable cost (1982 dollars). The underground-disposal costs do not include cost savings that could be realized in the preparation plant and treatment facilities at the surface. Preliminary tests of the system were conducted at the surface because funding restrictions prevented an in-mine trial.

17641 **A theoretical and experimental investigation of deposition rates and heat transfer properties of deposits formed in a direct coal-fired combustion environment.** Ramezan, M.; Ross, J.S.; Anderson, R.J.; Nagarajan, R. (U.S. Dept. of Energy, Morgantown Energy Technology Center, Morgantown, WV 26507-0880). pp 905-915 of Proceedings of the 4th annual Pittsburgh coal conference. Greensburg, PA; MEMS (1987). (CONF-870942—).

From 4. annual Pittsburgh coal conference; Pittsburgh, PA, USA (28 Sep 1987).

The fraction of impacting supermicron ash particles in coal-fired heat engines that actually sticks to the impingement surface is influenced by the simultaneous deposition of lower melting inorganic compounds, present as precursor vapors and/or submicron mists in the product gases of coal combustion. Small volumes of diffusionally deposited molten "glue" (alkali sulfates) in the deposit surface layer can enhance particle capture to a significant extent via "liquid bridging" within the powdery deposit. Owing to improved interparticle contact associated with liquid bridging, the time-dependent thermal conductivity of the sintering multiphase fouling deposit responds equally sensitively to small glue inventories. Because of these glue/particle couplings, the inertial particle deposition rate cannot be specified in advance but will seek a quasi-steady value such that the available glue will, as it were, "allow" the particles to be captured. Using quantitative laws governing convective-diffusion glue deposition rates and interim relations between the particle sticking fraction and glue volume fraction in the deposit surface layer, we exploit the model of "self-regulated" sticking of impacting particles to analyze deposition phenomena in the DOE/METC combustion/deposition entrained reactors. Illustrative computations and preliminary comparisons with experimental data are presented here and tentative conclusions are drawn regarding the appropriateness of our descriptive/predictive model for the rate of growth of the multi-phase fouling deposit and the time-evolution of its thermophysical properties.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 17409, 17410, 17412, 17561, 17601, 17669, 19256, 19268, 19288

17642 **(DOE/ER/60006—6) Chemical reactivity of polycyclic organic compounds adsorbed on coal fly ash and related solid surfaces: Final report, July 1, 1984-June 30, 1987.** Mamantov, G.; Wehry, E.L. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). Sep 1987. Contract AS05-81ER60006. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004517/JAW.

Our work has largely been concerned with the phototransformation of PAHs adsorbed on coal ashes and on various model adsorbents (silica gel, activated alumina, porous glass, graphite). PAHs investigated were: pyrene, anthracene, benzopyrene, benzanthracene, and phenanthrene. PAH vapors were deposited onto adsorbent surfaces. Some were illuminated. Adsorbents were then analyzed for PAH content. Results of chemical composition of adsorbents are presented. Observed reactivities of the PAHs are summarized. It was found that the carbon content of fly ash affected the photodecomposition. Fractionation of coal ashes was then performed. Enthalpies of adsorption of PAHs on ash and the adsorption isotherms for pyrene are presented. Also included in this study is the reactivity of PAHs in the presence of NO_2. 85 refs., 8 figs., 9 tabs. (CBS)

17643 (DOE/METC—87/6079-Vol.1, pp 289-298) **Environmental engineering and analysis.** Page, G.C.; Skinner, F.D.; Raden, D.P. (Radian Corp., Austin, TX). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The primary objective of this project is to obtain and evaluate environmental data for advanced synthesis fuel technologies and associated pollution controls (such as gas cleanup and wastewater treatment). Work under the Environmental Engineering and Analysis Project has been organized into three separate task areas, each

of which is described: (1) environmental, health, and safety program plan implementation; (2) site sampling and analysis; and (3) engineering analysis of pilot-, PDU-, and commercial-scale data. Results from each task are summarized. 8 references.

17644 (EPRI-AP—5343-SR, pp 16.1-16.16) **NO/sub x/ emissions from advanced gas turbines fired on MBtu gases.** Davis, L.B.; Hilt, M.B.; Schiefer, R.B. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920087/JAW. (CONF-8610351—).

From 6. annual EPRI contractors' conference on coal gasification; Palo Alto, CA, USA (15 Oct 1986).

This paper discusses the impact on NO/sub x/ and CO emissions when burning non-conventional fuels such as Low and Medium Heating Value coal gases. Experimental data from several test programs are presented. The results described show that NO/sub x/ emissions levels are strongly dependent on the stoichiometric, adiabatic flame temperature of the fuel. Preliminary test data show that higher NO/sub x/ emissions can be expected from typical straight MBtu gases rather than from distillate oil. Adequate control can be accomplished by adding diluents to the fuel to lower flame temperature, by effecting combustor modifications, or by a combination of the two. 11 references, 18 figures, 2 tables.

17645 (EPRI-AP—5343-SR, pp 17.1-17.35) **Preliminary environmental monitoring results for the Cool Water coal gasification program.** Grover, R.W.; Page, G.C.; Wetherold, R.G.; Wevill, S.L. Oct 1987. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920087/JAW. (CONF-8610351—).

From 6. annual EPRI contractors' conference on coal gasification; Palo Alto, CA, USA.(15 Oct 1986).

This paper presents preliminary environmental monitoring results for the Cool Water Coal Gasification Program (CWCGP). These results focus on the gaseous, aqueous, and solid streams discharged from the CWCGP, on pollution control process performance, and on ambient air and ground water monitoring. Data derived from the CWCGP Environmental Monitoring Program (EMP) will be developed into an environmental data base defining the environmental, health, and safety aspects of synthetic fuel production and the performance of the pollution control technologies used at CWCGP. This data base is being used during the operation of the CWCGP, and will provide operational and environmental design data for second generation facilities. 3 references, 1 figure, 13 tables.

17646 (NP—8770046, pp 168-173) **Development of the environmental protection technology. Environmental safety test of coal liquefied oil.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

For the development of the coal liquefaction technology, the environmental safety test of oil has been carried out since FY 1984, and will be continued till FY 1992. In FY 1985, the evaluation test was carried out, and main studies were acute oral toxicity, primary dermal irritation, primary eye irritation, phototoxicity, and acute fish toxicity. In these studies, the toxicities of 3 fractions, i.e. light oil, middle oil, and heavy oil of liquefied bituminous coal collected from bench scale operation. Results are as follows: 1)The results of acute oral toxicity test indicated all three fraction have very low oral toxicity to male rat and female rat with SD rats. 2) The results of primary demal irritation test with rabbits indicated that irritating substances are contained in large amount in low-boiling oil. 3) The results of primary eye irritation test with rabbit, indicate irritating substances are contained in large amount in low boiling oil. 4) The results of skin phototoxicity test with guinea pigs, suggest that the high boiling oil may contain substances which induce phototoxicity. 5) The results of microbal mutagenicity test with Ames indicate that the high boiling oil contains large amounts of mutagens. 6) The results of the preliminary investigation of skin irritation indicates. There was possibility of liver disturbance caused by cutaneous absorption. 7) The results of acute fish toxicity test with carp and killi fishes indicate that high boiling oil has strong acute toxicity. (2 tabs)

0110 Reserves And Exploration

REFER ALSO TO CITATION(S) 17599, 18353

17647 (NP—8770039, pp 22-46) **Fundamental investigation for the development of coal resources in the area of Ariake Sea.** Endo, Kazuko. (Mitsui Coal Mining Co., Ltd.). 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

The present mining area in the Miike coal mine has reached 8 kilometers off shore and the expanse of coal seams has been considered to be limited to east side of Minenosu barrier (upheaved basement) lies in the direction of south and north, but recently the area of the existence of coal seams has become to be considered to extend to the west side of the barrier. And in order to assure the possibility of the existance of coal resources and the condition of soil property in the west area of Miike coal mine, or the central area of Ariake Sea, we have done drilling and geophysical prospecting. With use of marine platform, 4 holes were drilled to 850-1157 meters deep, and in these holes physical logging and vertical seismic profiling were done and moreover analysis and test of coal samples and analysis of Forminifera fossil were done. As geophysical prospecting, seismic reflection method by air-gun was chiefly used and also gravity and magnetism were measured from ship. The results of drilling have proved that each hole shows 4-6 coal seams of good quality more than 1 meter thick and these seams are quite similar to coal seams in Miike coal mine and the most thick one is 4.4 meters thick and the total sum of coal seam thickness reaches 7.2-10.8 meters and coal seams exist 500-1,100 meters deep and could be mined. In geophysical prospecting coal-bearing formations of palaeogene coincides well with the results of drilling and the fault of Ariake Sea was found. From these data, promising coal resources are considered to exist in this area.

17648 (NP—8770039, pp 47-55) **Project of Berau coal.** Kishimoto, Mitsuo. (Nissho Iwai Corp., Tokyo, Japan). 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

From the viewpoint of dispersion of coal supply sources, Indonesian coals that marine transportation distances to Japan are short, are selected. And the fundamental investigation in east KALIMANTAN started from 1977, and thereafter ,between P.T.BERAU COAL and BATUBARA, cooperation agreement for the prospecting, development and production of coal resources in BERAU area was signed legally. As the result of 2 years' general investigation, prospective coal seams are assured to exist in both areas, north LATI and middle BINUNGAN, and at the same time the preliminary investigations of the route of the BERAU River for the method of transportation and shipping of coal were done. In the main areas of LATI and BINUNGAN, 39holes were bored and coal reserves of 150 million tons have been assured and hereafter 300 million tons reserves are expected in all in western area of LATI mine. In BINUNGAN area reserves have not been investigated enough yet, but are expected to be in considerable quantity. The quality of coal of LATI area is 5,800-5,900 kcal/kg and amount of ash is 3-4 %, and the thickness of coal seams is 1-5 meters. Mining will be done with trucks and shovels and coal will be transported by belt conveyer and barges directly to the large vessels off shore. Main demands of coal in Indonesia are for power plant and cement industries and at present coals are imported partially, but enough surplus for export is expected by this development. (8 figs, 1 tab)

17649 (NP—8770044, pp 14-33) **Basic survey on coal resources in Ariake Sea area.** Masui, Mitsuharu. (Mitui Coal Mining Co. Ltd., Tokyo, Japan). 21 Sep 1984. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

In Proceedings of parallel sessions for the 4th NEDO general assembly.

This is a contracted NEDO project. Potential existance of coal resources and geological conditions were studied and the following information was acquired. Area examined is the Ariake Sea area with breadth of 12 km (east to west) and 17 km (north to south) between the Miike Coal Mines and the Karatsu Coal Mines. Investigation was made by a marine drilling (depth being 864.8 m and 865.2 m below the sea bottom) and by a marine seismic method. Existence of coal bed groups comparable with the coal bed in the trial section of the Miike Coal Mines was confirmed by the two-drill trial. This indicates that the west end line of the Miike Coal Mines lies further west of the line connecting the Chikugo barrier and the Minenosu barrier. Investigation by a marine earthquake indicates that the upper surface of the coal beds in the investigated area is distributed in the depth of 400 - 1,100 m below the sea level, and that the basic surface is situated at the depth of 700 - 1,400 m below the sea level. This suggests the possibility that the coal beds of the Miike Coal Mines are distributed to reach the western part of the Ariake Sea. (9 figs, 3 tabs)

17650 (NP—8770044, pp 34-36) **Outline of comprehensive study on Canadian coal.** Tobise, Shuji. (New Energy Development Organization, Tokyo, Japan). 21 Sep 1984. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

In Proceeding of parallel sessions for the 4th NEDO general assembly.

This is a contracted study for NEDO carried out by Fluar Canada. The provinces of British Columbia and the Alberta were studied mainly with the assumption of coal supply to Japan. Raw coal of western Canada requires the preparation as described below. This results in rather high cost at the mines. 1) Plains coal and foothill coal require an intensive drying to reduce to transported water and to increase the heating value. 2) Surface treatment is required for preventing the degradation of coal and of spontaneous combustion. 3) Bentonite coal requires a drying treatment. The railway fare in Canada is determined by a transportation contract. Out of the contracted items, nothing is disclosed except the basic rates. There is not much hope for rate reduction, although there may be a certain room for negotiation. Coal production capacity is presently sufficient to meet the demand in and out of Canada. Both production and transportation of coal are administrated by the provincial government, not by the Dominion. Transportation facilities and harbor facilities are both complete, especially is the latter. Labor relations are also stable. (1 fig, 5 tabs)

17651 **(NP—8770044) Proceedings of parallel sessions for the 4th NEDO general assembly.** (New Energy Development Organization, Tokyo (Japan)). 21 Sep 1984. 471p. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

Papers given at the 4th NEDO general assembly have been entered individually into the EDB and ERA.

17652 (NP—8770045, pp 7-19) **Geological structure of Ryuzhuang area of Zhunan mine in Anhuisheng, China.** Uesaka, Takeshi. (Mitsubish Mining and Cement Co. Ltd., Tokyo, Japan). 20 Sep 1985. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

In Proceedings of parallel sessions for the 5th NEDO general assembly.

In accordance with a request for a coal survey by the ministers' conference of Japan and PRC held in December, 1980, a practical program was advanced jointly with the PRC Coal Development Corporation and a Japanese group in which NEDO was a liaison center. And a basic agreement was signed on the Ryuzhuang mining area of Zhunan Coal Mine in Anhui-sheng. And a detailed survey was performed using technologies such as seismic prospecting, boring, geological survey, stratum survey and chemical analysis. And in order to prepare a geological report ultimately recuired for the design of the coal mine, a field survey has been conducted since 1983. The outline is as follows: (1) Ryuzhuang mining area as an objective for survey covers an area of 75 km^2 extending 15 km in East and West, 3.5 - 7.0 km in South and North with the earth's surface 20 - 30 m above the sea level, and is a wheat field. (2) The geology is formed by an Ordovician layer of the lower Palaeozoic era as a basic stratum above which an coal layer, a Permian period layer and a Mesozoic era layer is developed with a sloping structure being covered by a thick Quatenary period layer. (3) The objective for RAD is the coal layer. Thus, it was found that the survey should be performed by boring. In the meantime, a seismic prospecting was carried out all over the area in a period from 1982 to March, 1984. The boring work amounted to 20 holes and 15,385 m in total length. The work clarified the coal deposit condition of the mining area and a good survey result was obtained. (6 figs, 3 tabs)

17653 (NP—8770045, pp 20-35) **Basic Survey on development for coal resources off the Kushiro coast.** Fujino, Toshiro. (Taiheiyo Coal Mining Co. Ltd.). 20 Sep 1985. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

In Proceedings of parallel sessions for the 5th NEDO general assembly.

Kushiro Mine has a land deposit in a region extending about 90 km in east and west from Uraboro District to Oboro District, and about 40 km south and north from the seashore to Hokuyo District towards the inland areas. Taineiyo Coal Mine has a mining area extending about 8 km from the seashore to offshore and bout 10 km east and west and as shown by the example, it is presumed that a coal holding layer including thick coal layers good for mining is expanding continuously towards the sea area. And it was decided to perform an offshore geophysical prospecting to survey the distribution of the stratum and the geological structure, and find out the depth of the coal layers and a deposit good for development. An offshore survey on the spot was performed using a geophysical survey ship, Western Pacific (owned by Western Geophysical Co.) and the survey record thus observed was processed by a computer by a joint venture as shown on a flow-chart in this report. The result of the survey is as follows: (1) By means of a reflective seismological survey, a reflective surface (P 3 horizon) of old tertiary period Uraboro layers, and a reflecting surface (P 5 horizon) considered as existing in the neighborhood of the boundary of Uraboro conglomerate layer and Shunsai coal holding layer could be followed comparatively clearly all over the survey area. (2) The geological structure of the Uraboro layers including the coal holding layers may be divided into three substructures. (3) The Uraboro layers with a promissing coal deposit by the survey is considered as being distributed in shallow water of an extensive area. (7 figs, 2 tabs)

17654 **(NP—8770045) Proceedings of parallel sessions for the 5th NEDO general assembly.** (New Energy Development Organization, Tokyo (Japan)). 20 Sep 1985. 456p. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

Papers given at the 5th NEDO general assembly have been entered individually into EDB and ERA. (LTN)

17655 (NP—8770046, pp 218-232) **Basic survey for coal resources development.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

Aiming at stable coal supply which occupies an important role as energy substitute for petroleum, as a link in surveys necessary to promote development of coal resources abroad, out of those areas with high reliability as coal resources inside and outside of Japan, by carrying out geophysical exploration and drilling in unexplored districts, a general outline of the overall geological construction and coal bed distribution, etc., can be grasped. This survey has been carried out in FY 1982-1984 in the 2 districts in Kyushu, ARIAKE SEA and OFF NISHI SONOGI and 5 districts in Hokkaido, OFF KUSHIRO, SHINJO,KITA ASHIBETSU, HOKUYO and RUSHIN to verify the coal bed and ascertain distribution conditions. Countinued surveys in these districts so as to grasp the geological construction of the district. Through these surveys, Japanese techniques in coal drilling prospecting, geophysical exploration and data processing have been found useful.

0120 Mining

REFER ALSO TO CITATION(S) 17666, 18353, 18386

17656 (DOE/EIA—0125(87/3Q)) Coal distribution, January-September 1987. (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 19 Jan 1988. 97p. NTIS, PC A05/MF A01 - GPO; 1; GPO Dep. Order Number DE88005265/JAW.

US coal distribution to domestic and foreign markets totaled 675.8 million short tons from January through September 1987. This was 1.6% more than the 665.2 million short tons distributed during the same period of 1986. Shipments exceeded production slightly as producers and distributors reduced their stockpiles to meet an increased demand for coal by domestic users. Production and/or purchases of coal in the United States reached 672.7 million short tons during January through September 1987, exceeding by 1.1% the 665.6 million short tons produced in the comparable period of 1986. During the third quarter of 1987 (July-September), distribution of coal totaled 237.6 million short tons or 2.2% more than production of 232.5 million short tons, and coal stocks dropped to 28.7 million short tons at the end of September. 6 figs., 33 tabs.

17657 (BMFT-FB-HA—86-024) Improvement of underground climates by the surface and underground installation of cryogenic equipment. Final report. Altena, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.); Ruhrkohle A.G., Essen (Germany, F.R.)). Dec 1986. 100p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751802/JAW.

A novel type of central refrigerating system is described which has a higher temperature gradient between flow and return temperature than the commonly used systems. This is achieved by an underground water cooler to the system consisting of a surface refrigerator and an underground heat exchanger, so that large heat flows can be transported with minimum coolant mass flows, i.e. through narrow pipelines. This way, the efficiency of the refrigerating system is increased, which is important in view of the increasingly difficult mining conditions. A refrigerating plant was developed to maturity in the course of the project. The system has a refrigerating capacity of 6 MW; it supplies cold to all operating points and thus improves miners' working conditions. With 13 refs., 15 tabs., 27 figs..

0130 Transport And Handling

REFER ALSO TO CITATION(S) 17407, 17650

17658 (DOE/METC—87/6079-Vol.1, pp 341-350) Reduction of erosion in elbows due to flow field modifications. Johnson, E.K.; Means, K.H.; Flemmer, C.; Holtzworth, J.D. (West Virginia Univ., Morgantown). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1). Contract AC21-84MC21349.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

Coal and other solids are commonly transported through pipes as a gas-solids mixture. Pneumatic transport systems usually contain at least one elbow (bend) in the flow path. The erosion that occurs in these devices presents problems in both the design and operation of these transport systems. The purpose of this contract is to investigate the potential for modifying the flow field within an elbow (bend) in order to reduce the erosion rates. Conceptually, jets would move the eroding particles away from the surfaces where the erosion rates are normally the greatest. Also, the particles would be given additional momentum, directed downstream of the bend, thus reducing the pressure drop and acceleration length associated with a standard bend. Because of the lack of knowledge concerning gas-solids mixtures flowing in bends, this contract was formulated in two parts. Part I was an exploratory study to determine if the concept had any merit. Part II is intended to produce more detailed information if the results of Part I warranted further study. Experimental work and preliminary results are described.

17659 (DOE/PC/90958—T3) Study of dense phase cohesive coal transport in plugs: Quarterly report, September-November 1987. Klinzing, G.E. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). 1987. Contract FG22-86PC90958. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003397/JAW.

This report discusses the potential delivery of cohesive coal in pipelines and is divided in two parts: plus flow study in opaque pipeline (carbon steel pipe) for the horizontal and inclined conveying; and plug flow stability in 2.0 inches and 4.0 inches vertical transparent PVC pipes. 11 figs.

0140 Combustion

REFER ALSO TO CITATION(S) 17407, 17409, 17410, 17412, 17418, 17419, 17420, 17421, 17422, 17423, 17427, 17463, 17471, 17474, 17475, 17476, 17479, 17487, 17488, 17496, 17526, 17578, 17608, 17614, 17622, 17623, 17628, 17641, 17644, 18125, 18126

17660 (ANL/CNSV—61) Tests to produce and recover carbon dioxide by burning coal in oxygen and recycled flue gas: Black Hills Power and Light Company Customer Service Center Boiler No. 2, Rapid City, South Dakota. Kumar, R.; Fuller, T.; Kocourek, R.; Teats, G.; Young, J.; Myles, K.; Wolsky, A. (Argonne National Lab., IL (USA)). Dec 1987. Contract W-31109-ENG-38. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005570/JAW.

Experiments were conducted using a modified stoker-fired boiler (2.2×10^6 Btu/h) instrumented to examine the feasibility of producing and recovering carbon dioxide by burning coal in oxygen and recycled flue gas in a utility environment. The tests demonstrated that the boiler can be operated in the oxygen-blown/flue-gas-recirculation mode without any noticeable effects on coal combustion, heat delivery to the water, or the coal-feed or ash-handling systems. Pretest calculations showed that a feasible set of operating parameters for a carbon-dioxide-producing combustor system tightly sealed against air infiltration and containing no more than about 5% O_2 (dry basis) at the furnace exit would be a flue-gas recycling ratio between 0.6 and 0.7 and an oxygen feed rate of 1.17 g-moles per g-atom of carbon, yielding an exhaust gas composition (wet basis) of approximately 46.9% CO_2, 50.6% H_2O, and 2.5% O_2. This composition corresponds to a product gas containing 95% CO_2 and 5% O_2 (dry basis). However, because air leaked into the test combustor and the flue-gas handling system, the highest carbon dioxide concentration achieved in the exhaust gas was 48.5% (dry basis). Major sources of inleakage were the furnace brickwork, the gas-handling system, and the coal-feed and ash-extraction systems. 40 figs.

17661 (DOE/FC/10287—2416) Investigation of mechanisms of ash deposit formation from low-rank coal combustion: Final report. Greene, F.T.; O'Donnell, J.E. (Midwest Research Inst., Kansas City, MO (USA)). Aug 1987. Contract AC21-81FC10287. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE87006526/JAW.

This project was undertaken to determine the chemical behavior of alkali metal and other species implicated in the ash fouling which can occur during the combustion of low rank coals. The coal combustion was studied in unaugmented premixed pulverized coal flames. Vapor species were measured by molecular beam mass spectrometry. Temperatures were also measured, and time-resolved coal/ash particulate samples were collected and analyzed. A major part of the research on this project was devoted to: (1) the development and refinement of techniques for the MBMS analysis of trace quantities of unstable and reactive high temperature vapor species from the pulverized coal flames; and (2) the time-resolved sampling and collection of particulates. The equipment is now operating very satisfactorily. Inorganic species, some of which were present at parts-per-million levels, were quantitatively sampled and measured in the pulverized coal flames. Time-resolved particulate samples which were free of vapor deposited contaminants were collected without the use of an interfering substrate. Profiles of the alkali metal species in Beulah lignite and Decker subbituminous coal flames were obtained. It was found in both flames that sodium is volatilized as the atomic species early (milliseconds) in the combus-

tion process. The gaseous Na reacts, also in milliseconds, to form an unknown species which is probably an oxide fume, but which is not NaOH or Na_2SO_4. This is probably the mechanism for the formation of the alkali "fumes" observed in other systems. Measurements were also made of a number of other gaseous species, and time-resolved coal/ash samples were obtained and analyzed. 27 refs., 23 figs., 8 tabs.

17662 **(DOE/FE—0096) The role of repowering in America's power generation future.** Dec 1987. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004505/JAW.

17663 **(DOE/PC/90756—T2) Research on thermophoretic and inertial aspects of ash particle deposition on heat exchanger surfaces in coal-fired equipment: Quarterly technical report, September 1, 1987-November 30, 1987.** Rosner, D.E. (Yale Univ., New Haven, CT (USA). High Temperature Chemical Reaction Engineering Lab.). Dec 1987. Contract FG22-86PC90756. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004988/JAW.

DOE-PETC has initiated at the Yale HTCRE Laboratory a systematic three-year experimental and theoretical research program directed toward providing engineers with the data, methods, and rational correlations needed to dramatically improve the generality and accuracy of prediction of inorganic particle deposition rates under typical coal combustion conditions (i.e., those leading to the importance of thermophoretically-enhanced diffusion (submicron mode) and the inertially-enhanced "impaction" (supermicron mode)), often in the presence of simultaneous alkali salt vapor condensation. 9 refs., 1 fig.

17664 (NP—8770045, pp 36-55) **Technology trend on the international slurry symposium.** Yugami, Hiroshi. (Electric Power Development Co. Ltd., Tokyo, Japan). 20 Sep 1985. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

In Proceedings of parallel sessions for the 5th NEDO general assembly.

This study was performed as a link forming a chain of research work funded by NEDO. Coal liquefaction technologies were started from COM and moved towards CWM, and at present are making progress to the commercialization dealing with the utilization. Under such a condition, U. S. Department of Energy (DOE) held an international symposium to promote an exchange of informations between researchers, developers and users. The first symposium was held in 1978, and it was held for seven times until this year (1985). The international slurry symposium opened this time was marked as a step for the commercialization of CWM, and the number of announced papers amounted to 110 increasing by 12 over the last occasion, and the participants exceeded 800 persons. (1 fig, 2 tabs)

17665 **Update on the TIDD PFBC demonstration project.** Bauer, D.A.; Stogran, H.K.; Hemenway, L.F. (Mechanical Engineering Div., American Electric Power Service Corp., Columbus, OH 43215). pp 659-670 of Proceedings of the 4th annual Pittsburgh coal conference. Greensburg, PA; MEMS (1987). (CONF-870942—).

From 4. annual Pittsburgh coal conference; Pittsburgh, PA, USA (28 Sep 1987).

Pressurized Fluidized Bed Combustion (PFBC) is a clean coal technology which is now proceeding to demonstration plant status. American Electric Power (AEP) has been a leader in the development of PFBC in the United States. With a background of over ten year's involvement in this technology, AEP is now performing the detailed design and material procurement for the 70-MW Tidd PFBC Demonstration Plant to be built in Brilliant, Ohio. This project is being co-funded by AEP, the Department of Energy - as a Clean Coal Technology Project, and the State of Ohio. The present schedule is for groundbreaking in 1988 and startup in 1990. This paper provides a description of the Tidd PFBC Demonstration Plant, the PFBC Island, and the integration of PFBC technology into the balance-of-plant systems.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 17412, 17491, 17563, 17650, 17656, 17702, 17703, 18385

17666 **(DOE/EIA—0118(86)) Coal production, 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 28 Jan 1988. 171p. NTIS, PC A08/MF A01 - GPO; 1; GPO Dep. Order Number DE88005771/JAW.

Coal Production 1986 provides comprehensive information about US coal production, the number of mines, prices, productivity, employment, productive capacity, reserves, and stocks to a wide audience including Congress, Federal and State agencies, the coal industry, and the general public. The data presented in this report were collected and published by the Energy Information Administration (EIA), to fulfill its data collection and dissemination responsibilities as specified in the Federal Energy Aministration Act of 1974 (P.L. 93-275) as amended. The 1986 coal production and related data presented in this report were obtained from companies owning mining operations that produced, processed, or prepared 10,000 or more short tons of coal in 1986. This survey originated at the Bureau of Mines, US Department of the Interior. This report also includes updated data for the demonstrated reserve base of coal in the United States on both January 1, 1986 and January 1, 1987. This is the seventh annual summry on minable coal, pursuant to Sec. 801 of Public Law 95-620. 18 figs., 105 tabs.

17667 (NP—8770039, pp 7-21) **Survey of the expansion of coal trade in the Pacific countries.** Hosaka, Komao. (New Energy Development Organization, Tokyo, Japan). 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

This survey has been carried out to realize and promote the 'Idea of Coal flow program in the pacific countries' made by the Ministry of Trade and Industry, Japanese Gov't,, as well as to analyze the significance of the expansion of the coal flow and determining the directionality of the needs and cooperation of the various countries concerning the coal flow expansion and to study the role of Japan in future cooperation. This report is a compilation of the summary of Annual Survey Reports for FY 1984 and FY 1985. The object of this survey has included Korea, Formosa, China, Philippines, Thailand, Malaysia, Singapore and Indonesia. Various countries, in proportion to increasing demands for coal, have increased their purchases of overseas coal each year and the needs for supply of information regarding the World coal market trends and outlook of demands, etc., is increasing. As a means of collecting information there are demands for setting up a data bank concerning coal and for establishing an agency such as the ACIC (ASEAN Coal Information Center) that can be utilized by the various countries and there is the need for Japan to cooperate in the establishment thereof. (4 tabs, 3 figs)

17668 **(NP—8770039) Proceedings of parallel sessions for the 6th NEDO general assembly.** (New Energy Development Organization, Tokyo (Japan)). 19 Sep 1986. 482p. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

A survey concludes that Asian countries should cooperate in setting up an information system about the coal needs and coal supplies of the various countries. Individual articles have been entered individually into EDB and ERA. (LTN)

0160 Health And Safety

REFER ALSO TO CITATION(S) 17646

17669 **(PB—88-124912/XAB) Acid-producing potential of the various lithic units associated with the mining of coal. Technical completion report.** Renton, J.J.; Stiller, A.H. (West Virginia Univ., Morgantown (USA). Water Research Inst.). 1986. 27p. NTIS, PC A03/MF A01.

A collection of the seven different potentially toxic lithotypes encountered in the mining of coal were collected for five coals in 18 mines over a 5 county area in northern West Virginia for a total of 89 samples. Each sample was subjected to total sulfur analysis and to the soxhlet extraction/oven reoxidation procedure devised by the authors for the evaluation of an acid-production rate constant, alpha. The data show that the samples with the lowest sulfur contents have the highest acid production rate constants.

17670 **(PB—88-128368/XAB) Third round of medical examinations for working underground coal miners.** (National Inst. for Occupational Safety and Health, Morgantown, WV (USA)). 1977. 5p. NTIS, PC A02/MF A01.

This pamphlet describes the third round of medical examinations required under the Federal Coal Mine Health and Safety Act of 1969 for working underground coal miners. The medical examination program was administratively divided into three rounds, with the third round to begin in 1978. The program included the following points: the filing of a worker examination plan with NIOSH; posting plans at the worksite; mine operators paying for examinations; x rays being read by specially trained radiologists; notifying workers of the results of the examinations; passing changes in regulations along to the mine operators; compiling disease surveillance statistics; and publication of a periodic surveillance report.

17671 **(PB—88-130778/XAB) Free chest x rays for working underground coal miners: questions and answers.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 1987. 8p. NTIS, PC A02/MF A01.

This pamphlet provides information on free chest x rays available to working underground coal miners under the Federal Coal Mine Health and Safety Act of 1969. The Act provided that underground coal miners were eligible to participate in a chest x-ray program for the diagnosis of coal-worker's pneumoconiosis. Topics discussed in this pamphiet included coal workers' pneumoconiosis, mine operator payment for x-ray examinations of workers, arrangements for examinations, interpretation of the x rays by physicians, notification of the results, additional medical information from the x-ray examination, black-lung benefits, and general benefits of participation in the examination program.

17672 **(PB—88-130810/XAB) Methods for the selective sampling of diesel particulate in mine-dust aerosols. Open File Report, 27 August 1984-26 July 1986.** Marple, V.A.; Kittelson, D.B.; Rubow, K.L.; Fang, C.P. (Minnesota Univ., Minneapolis (USA). Particle Technology Lab.). Oct 1986. 101p. NTIS, PC A06/MF A01.

This paper describes an investigation into time-integrated and real-time methods for determining the diesel-exhaust particulate concentration in underground mines, particularly coal mines. The micro-orifice uniform deposit impactor is recommended for obtaining the time-integrated measurement of the size distribution. The mass concentration of diesel-exhaust particles can be obtained from the particle size distribution of mine aerosols. On a mass basis, diesel-exhaust particles are primarily in the submicrometer size range while coal dust particles are larger. Size distribution measurements made in the laboratory and in three underground coal mines exhibited two distinct modes with the diesel-exhaust particles in the smaller particles mode and the coal particles in the larger-particle mode. The point of separation between the two modes occurred in the 0.7- to 1.0-micrometer size range. The separation was found to be independent of mass fraction of the diesel exhaust particles, particle concentration, and sampling site. Methods recommended for further consideration as real-time monitors of diesel exhaust aerosols in mines are photometers and filter pressure drop techniques. A preclassifier would be required in both cases to separate the larger dust particles from the sample.

17673 **(PB—88-130976/XAB) Study of r-f hazards at low and medium frequencies to blasting in underground coal mines. Open file report, 1 February 1981-30 November 1984.** Thompson, R.H.; Stuart, J.G.; Cipkins, A.W. (Franklin Research Center, Philadelphia, PA (USA)). Jan 1985. 319p. NTIS, PC A14/MF A01.

The paper presents the preliminary safe distances for blasting wiring from typical electromagnetic sources. The distances are for underground coal mines and electromagnetic sources in the frequency range below 10 MHz. The distances are based on measurements performed at three locations in each of three coal mines. The measurement apparatus, measurement procedure, measurement results, and the rationale used in the calculation of the safe distances are all described. The safe distances presented are dependent on the measurement results and their interpretation. More measurements are clearly necessary to establish the validity of the suggested distances.

0170 Legislation And Regulations

REFER ALSO TO CITATION(S) 17650

02 PETROLEUM

0201 Reserves

17674 **(DOE/EIA—0370(87)) Oil and gas Field Code Master List, 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 22 Dec 1987. 658p. NTIS, PC A99. Order Number DE88004325/JAW.

This is the sixth annual listing of all identified oil and gas fields in the United States. It is updated with field information collected through November 1987. The purpose of the publication is to provide codes for easy identification of domestic fields. Standardization on these field codes will foster consistency of field identification by government and industry. The use of field names and codes listed in this publication is required on survey forms and other reports regarding field-specific data collected by the Energy Information Administration and the Federal Energy Regulatory Commission. A glossary of key terms is provided. 9 figs., 4 tabs.

0202 Geology And Exploration

17675 **(DOE/ER/13470—1) Workshop on organic geochemistry and the Continental Scientific Drilling Program: Final report.** (Oklahoma Univ., Norman (USA)). 1986. Contract FG05-86ER13470. 444p. (CONF-8601136—). NTIS, PC A19/MF A01; 1; GPO Dep. Order Number DE88004430/JAW.

From Workshop on organic geochemistry and the continental scientific drilling program; Norman, OK, USA (1 Jan 1986).

The workshop was divided into a number of sessions involving presentation of scientific papers on topics directly related to continental scientific drilling and discussions designed to determine a scientific program that could be implemented as the organic geochemistry aspect of this program. This report is divided into a number of sections. The second section outlines the aims of the Norman workshop. The third summarizes the scientific presentations made at the workshop. The fourth section presents a summary of the discussion session. And finally, the fifth section discusses the major recommendations and suggestions arising from the workshop. Individual articles are processed separately for the data base.

17676 **(PB—88-128715/XAB) Draft environmental impact statement for proposed oil and gas Lease Sales 113/115/116, Gulf of Mexico OCS (Outer Continental Shelf) region.** Rouse, R.M.; Lehman, J.W.; Vaughan, C.L. (Minerals Management Service, New Orleans, LA (USA). Gulf of Mexico OCS Regional Office). Apr 1987. 557p. (MMS/GM/ES—87/003). NTIS, PC A24/MF A01.

See also PB—88-128723, and PB—87-118352.

This EIS is a description of the environmental aspects and impacts of oil and gas activities resulting from the lease sale or the states bordering the Gulf of Mexico. It provides a description of the area, affected environment, and environmental consequences; it discusses the proposed action, issues and areas of concern, and the major differences of holding the lease sale.

17677 **(PB—88-128723/XAB) Final environmental impact statement for proposed Oil and Gas Lease Sales 113/115/116, Gulf of Mexico OCS (outer continental shelf) region.** Rouse, R.M.; Lehman, J.W.; Holt, J.N. (Minerals Management Service, New Orleans, LA (USA). Gulf of Mexico OCS Regional Office). Oct 1987. 729p. (MMS/GM/ES—88/001). NTIS, PC A99/MF E04.

See also PB—88-128715, and PB—87-118360.

This EIS is a description of the environmental aspects and impacts of oil and gas activities resulting from the lease sale or the states bordering the Gulf of Mexico. It provides a description of the area, affected environment, and environmental consequences; it discusses the proposed action, issues and areas of concern, and the major differences of holding this lease sale.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 20649

17678 **(DOE/BC—87/1) Contracts for field projects and supporting research on enhanced oil recovery: Progress review No. 49, Quarter ending December 1986.** (USDOE Bartlesville Project Office, OK). Oct 1987. 99p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE87001239/JAW.

This document describes enhanced recovery research and field projects. The following topics are discussed: chemical flooding; gas displacement; thermal methods; resource assessment; environmental technology; and microbial technology. (FI)

17679 **(DOE/BC/10300—45) Microbial strains and products for mobility control and oil displacement: Final report for the period July 1, 1980-February 28, 1986.** Knapp, R.M.; McInerney, M.J.; Menzie, D.E. (Oklahoma Univ., Norman (USA). Dept. of Botany and Microbiology). Dec 1987. Contract AS19-80BC10300. 206p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88001203/JAW.

The objective of this work was to demonstrate that microorganisms and their products can enhance the recovery of oil from heterogeneous reservoirs. The particular focus of research has been on in situ processes including selective plugging to remedy permeability stratification. Using various experimental models of porous media, the feasibility of microorganisms to enhance oil recovery was systematically studied. It has been shown that many of the potential problems facing the application of microbial processes can be overcome. Topics discussed in the report are as follows: The effect of sterilization method on bacterial penetration through Berea sandstone; in-situ microbial growth and metabolism in Berea sandstone; selective plugging and oil displacement in crossflow core systems by microorganisms; effect of nitrate on biogenic sulfide production; characterization of polymer-producing bacteria; and the purification and properties of the biosurfactant produced by Bacillus Licheniformis Strain JF-2. 199 refs., 23 figs., 13 tabs.

17680 **(DOE/BC/10830—6) Evaluation of micellar-polymer flood projects in a highly saline environment in the El Dorado field.** Ferrell, H.H.; Easterly, R.A.; Murphy, T.B.; Kennedy, J.E. (Keplinger Technology Consultants, Inc., Tulsa, OK (USA)). Dec 1987. Contract AC19-85BC10830. 136p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88001202/JAW.

Two different micellar processes were conducted in the El Dorado Field in an effort to develop an EOR method for reducing the high oil saturation after waterflooding. Each process was field tested on adjacent 25 acre blocks of four 5-spot patterns. This report reviews the field performance, geology, formation evaluation, and laboratory support tests for the field tests. Both processes failed to recover additional oil, primarily because of unavoidable exposure to and mixing with divalent ions. An unusual oil saturation distribution also contributed to the failure. Unfortunately, these conditions could have been predicted from study of previous air, water, and steam injection projects in the field. 35 refs., 46 figs., 10 tabs.

17681 **(DOE/BC/10840—1) A technical and economic assessment of domestic heavy oil: Final report.** Dowd, W.T.; Kuuskraa, V.A.; Godec, M.L. (Interstate Oil Compact Commission, Oklahoma City, OK (USA); Lewin and Associates, Inc., Washington, DC (USA)). Jan 1988. Contract FG19-85BC10840. 205p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88001204/JAW.

This study provides an updated assessment of domestic heavy oil and estimates how much of this resource may be economically recoverable. Heavy oil, for purposes of this study, is defined as crude oil with an average gravity between 10° and 20° API. This study provides some of the basic information that may assist industry and researchers to more efficiently pursue this large 100 billion barrel domestic oil target. For this the study pursues five topics: the data base used by the study identifies the gepgraphic location and the key reservoir properties of domestic heavy oil fields; the analytical screening guides sort the heavy oil resource base for the most favorable deposits; the oil recovery models represent the two primary EOR technologies steam injection and in-situ combustion that are essential for recovering this challenging resource; the economic models capture the essential costs and financial features of heavy oil production; and the results of the study provide both an overall perspective as well as deposit-specific detail on the potential of heavy oil recovery. 39 refs., 36 figs., 56 tabs.

17682 **(DOE/BC/10843—5) Investigation of the application of gelled polymer systems for permeability modification in petroleum reservoirs: Final annual report for the period October 1985-September 1986.** Willhite, G.P. (Kansas Univ., Kansas City (USA)). Nov 1987. Contract AC19-85BC10843. 172p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88001201/JAW.

The research program is directed at improvement of volumetric sweep of fluid-displacement processes using gelled polymer systems. An integrated program is underway to develop a systematic procedure for the methods which can be used for design of gelled polymer applications. The program is organized into three parts: (1) physical and chemical description of gelling systems, (2) experiemental investigation of in situ gelation in porous media, and (3) correlation and mathematical modeling of in situ gelation. This report describes progress during the first year of a three-year program. 93 refs., 59 figs., 22 tabs.

17683 **(DOE/BC/10849—5) A systematic procedure for reservoir characterization: Annual report for the period October 1, 1985-September 30, 1986.** Lake, L.W.; Kocurek, G.A.; Miller, M.A. (Texas Univ., Austin (USA)). Dec 1987. Contract AC19-85BC10849. 273p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88001206/JAW.

This report deals with a variety of topics all centered around the main goal of making numerical reservoir simulation results conform more closely with geologic descriptions. The first part of the report discusses results on conditional simulations of miscible displacements in randomly heterogeneous permeable media. The focus here is on local or macroscopic dispersion, the dispersion experienced at a fixed point in the medium. Macroscopic dispersivity has many of the same dependencies on reservoir properties as does megascopic dispersivity, but it seems to be less time dependent and is always smaller. We have not discovered a mathematical model to describe its behavior. A major portion of the report deals with statistical descriptions. We investigate the bias and precision of standard measures of heterogeneity, the Lorenz and Dykstra-Parsons coefficient. After this, the work explores the benefits of using a distribution type characterization parameter in exploring heterogeneity. The final major protion of the report describes our mapping efforts on the Page sandstone outcrop in northern Arizona. The mapping is to be used in generating both deterministic descriptions and in calibrating the stochastic descriptions discussed above. 128 refs., 95 figs., 10 tabs.

17684 **(NIPER—288) Analysis of trends in enhanced oil recovery projects: Project BE2, Task 1, Milestone 3: FY87 research plan: Topical report.** Thomas, R.D.; Pautz, J.F. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Nov 1987. Contract FC22-83FE60149. 32p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004284/JAW.

Current trends in US enhanced oil recovery (EOR) project starts are analyzed for the period from 1980 to 1987 to determine what changes are occurring in the application of EOR. The analysis is based on the Department of Energy (DOE) EOR Project Data Base, which contains information on more than 1200 projects, and the Oil and Gas Journal. The National Institute for Petroleum and Energy Research (NIPER) maintains this data base and analyzes trends in the data for DOE through provisions of Cooperative Agreement FC22-83FE60149. The most noticeable trend is the steady decline in the number of project starts each year since 1981, which corresponds to the steady oil price decline during that period. Exceptions to this trend are polymer and carbon dioxide immiscible projects. Another trend seems to be toward choosing reservoirs with characteristics well within screening criteria, which makes them lower risk projects. True field experimentation with the attendant assumption of higher risk is on the decline. One notable exception is the initiation of three microbial EOR field projects in 1987. Planned projects for 1986 appeared to have reversed the decline in project starts; however, the sharp drop in oil prices caused companies to abandon some projects and postpone others. The new starts were almost always those with a large capital investment already made. Despits the temporary setback, long-term EOR prospects remain good, largely because EOR remains an economical source of new oil reserves and should play a key role in the drive to maintain oil production through the year 2000. 11 refs., 9 figs., 15 tabs.

17685 **(NP—8751800) Reservoir modelling for thermal recovery processes. Final report.** Mohtadi, M.; Jochheim, U.; Murtada, H. (VEBA-Oel A.G., Gelsenkirchen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1986. 53p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751800/JAW.

New methods were developed and tested in a heavy oil pilot project. Temperature logs were performed in the pilot for measuring the temperature within and above the reservoir. Furthermore thermal conductivity was measured in situ. A new geoelectric tool from Prakla Seismos GmbH was used for measuring frac orientation during hydraulic fracturing the reservoir. Steam flooding experiments were performed in the laboratory for evaluation of reservoir performance under thermal conditions and to achieve thermal parameters for reservoir simulation. Also thermal parameters were measured using original cores. A 3-dimensional model has been developed for numerical simulation of heavy oil reservoirs. The model was designed for simulation of steam injection as well as steam/CO/sub 2/ injection. With 29 refs., 17 figs..

17686 **(PB—88-130166/XAB) Gray whale, Eschrichtius robustus, bibliography. Final report.** Setzler-Hamilton, E.; Oliver, G.W. (Maryland Univ., Princess Anne (USA). Coastal Ecology Research Lab.). Jan 1987. 338p. NTIS, PC A15/MF A01.

See also PB—87-192118.

The report categorizes the research literature on gray whales according to major research topics, issues of concern to Outer Continental Shelf oil and gas development, and geographic areas. The report has an extensive cross-index. Selected references are depicted on an accompanying poster.

17687 **Effect of oil composition on minimum miscibility pressure - Part 1: Solubility of hydrocarbons in dense CO/sub 2/.** Silva, M.K.; Orr, F.M. Jr. (New Mexico Petroleum Recovery Research Center). *SPE (Society of Petroleum Engineers) Reservoir Engineering;* **2**: No. 4, 468-478(Nov 1987).

This paper examines the effect of oil composition on the phase behavior of CO/sub 2//hydrocarbon mixtures and, hence, on the development of miscibility in a CO/sub 2/ flood. Results of component-partitioning measurements are reported for mixtures of CO/sub 2/ with five synthetic oil systems: normal alkanes, branched alkanes, naphthenes, aromatics, and a mixture of all four molecular types. The results of the experiments indicate that unsubstituted ring structures are less soluble in dense CO/sub 2/ than branched or normal alkanes with the same number of carbon atoms, but that the addition of alkyl side chains to ring structures improves their solubility. Also reported are component-partitioning measurements for mixtures of CO/sub 2/ with three crude oils: Rock Creek (paraffinic), Maljamar (more aromatic), and Rock Creek plus 15 wt% of a mixture of aromatic components. The experimental results suggest that of the many factors that influence extraction of hydrocarbons by dense CO/sub 2/, the distribution of molecular weights present in the oil is the most important.

17688 **Effects of thermal and mechanical loading on PDC bit life.** Glowka, D.A.; Stone, C.M. (Sandia Natl. Labs.). pp 220-233 of Drilling. Richardson, TX; Society of Petroleum Engineers (1987).

Results of numerical analyses to determine the effects of thermal and mechanical loading on the integrity of polycrystalline-diamond-compact (PDC) cutters during deep-hole drilling are presented. Cutter-temperature distributions for several drilling environments are combined with the appropriate mechanical cutting loads to predict stress distributions for the study of cutter wear mechanisms. A discussion of wear mechanisms acting on the cutting structure is presented. Suggestions based on these analyses are presented for the operation of PDC bits to increase bit life in hard, abrasive rock drilling. Microstructural design considerations for the cemented carbide that supports the diamond layer are also discussed.

17689 **An evaluation of a steamflood experiment in a Utah tar sand deposit.** Johnson, L.A. Jr.; Fahy, L.; Romanowski, L.J. Jr.; Thomas, K.P.; Hutchinson, H.L. (Laramie Energy Technology Center, U.S. DOE). pp 411-418 of Numerical simulation II (1986). Richardson, TX; Society of Petroleum Engineers (1986).

The first U.S. DOE Laramie Energy Technology Center (LETC) steamflood experiment in a Utah tar sand, LETC TS-1S, was conducted in the Northwest Asphalt Ridge deposit near Vernal, UT. Steam was injected into the center well of two concentric inverted five-spot patterns. The zone chosen for the experiment was a sandstone 45 ft (14 m) thick in the Rimrock member of the Mesaverde formation. The pattern area was 0.25 acres (1012 m/sup 2/) and contained a 13°API (979 kg/m/sup 3/) bitumen with a viscosity greater than 10/sup 6/ cp (10/sup 3/Pa . s) at reservoir conditions. The average oil saturation was 78.9% PV. During 160 days of operation, 65,700 bbl (10.4 x 10/sup 3/ m/sup 3/) of water-equivalent steam were injected at 360 to 530 osig (2.5 to 3.7 MPa) and 180 to 650 B/D (29 to 103 m/sup 3//d). Total production during the test amounted to 1,150 bbl (183 m/sup 3/) of oil and 6,250 bbl (994 m/sup 3/) of water.

0204 Processing

REFER ALSO TO CITATION(S) 18773, 18793, 18799, 18801

17690 **(DOE/PE/76030—T1) From toppers to bottoms: A survey of Chinese refining.** Fridley, D. (East-West Center, Honolulu, HI (USA). Resource Systems Inst.). Aug 1987. Contract FG01-84PE76030. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005823/JAW.

A survey was conducted on petroleum refining in China. Included is information on processes, costs, development, transport problems, supply and demand, future trends, and trade. 5 figs., 9 tabs. (CBS)

17691 **(DOE/PE/76030—T2) China's Refinery Upgrading Program: An update.** Fridley, D. (East-West Center, Honolulu, HI (USA). Resource Systems Inst.). Nov 1986. Contract FG01-84PE76030. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005822/JAW.

China's refining industry was unable to respond to the changing demand structure by reliance on domestic technologies

alone. The first steps in reforming the system came during the sixth Five-Year Plan of 1980-1985, when the majority of China's refineries were consolidated under the China National Petrochemical Corporation, or Sinopec. Sinopec then began work on formulating an upgrading program for its refining system based on the renovation and expansion of existing facilities and the importation of selected technologies. The program is aimed at meeting the expected demand slate of petroleum products in the late 1980s and early 1990s. A survey of the projects reveals Sinopec's general development strategy and illustrates the future of product supply over the near term. The projects can be roughly divided into four categories: those that increase the depth of refining, increase the utilization of light ends, improve product quality, and expand petrochemical production.

17692 **Hydrodenitrogenation chemistry. I. Cleavage of alkylcarbon-nitrogen bonds, methane and ammonia formation in the HDN reaction of 1,2,3,4-tetrahydroquinoline with a nickel oxide catalyst supported on silica/alumina.** Fish, R.H.; Thormodsen, A.D.; Moore, R.S.; Perry, D.L.; Heinemann, H. (Lawrence Berkeley Lab., CA). *Journal of Catalysis;* **102**: No. 1, 270-273(Nov 1986). Contract AC03-76SF00098.

The hydrodenitrogenation reaction (HDN) is one of the most important industrial processes used in the refining of petroleum feedstocks and involves the removal of the nitrogen atom, as ammonia, from polynuclear heteroaromatic nitrogen compounds at high temperatures and high pressures of hydrogen gas (350-500°C and 2000 psi). It is interesting to note that most of the reported heterogeneous catalysts require the complete hydrogenation of both the nitrogen heterocyclic ring and the aromatic ring before carbon-nitrogen bond cleavage can occur. A major breakthrough in the technical and economic aspects of the HDN reaction would take place if, in fact a catalyst could be found that would selectively cleave the C-N bond din the saturated nitrogen ring and subsequently produce ammonia, without substantial reduction of the aromatic rings, at lower temperatures as well as lower pressures of hydrogen gas. In this note, the authors report on a highly loaded nickel oxide catalyst (50% by weight Ni), supported on silica/alumina, that will effectively provide some of the criteria for an ideal HDN catalyst. 8 references.

17693 **Transmission electron microscope study of the effect of cyclohexane adsorption on the crystallization of $Pd_{80}Si_{20}$ metallic glass.** Kowbel, W.; Brower, W.E. Jr. (Southern Illinois Univ., Carbondale). *Journal of Catalysis;* **101**: No. 2, 262-267(Oct 1986).

The strong effect of the adsorption of cyclohexane on the crystallization of metastable $Pd_{80}Si_{20}$ metallic glass was studied in situ via a high voltage electron microscope equipped with a hot stage and an environmental cell. The crystallization temperature of the $Pd_{80}Si_{20}$ glass was lowered by 200°C in 20 Torr of cyclohexane as compared to 10^{-6} Torr vacuum. The path of the solid state phase transformation in the bulk glass was also altered, since a different crystalline second phase formed in cyclohexane as compared to vacuum. 12 references.

17694 **Carbon and oxygen atom mobility during activation of Mo_2C catalysts.** Leary, K.J.; Michaels, J.N.; Stacy, A.M. (Lawrence Berkeley Lab., CA). *Journal of Catalysis;* **101**: No. 2, 301-313(Oct 1986). Contract AC03-76SF00098.

Temperature-programmed desorption (TPD) and reduction (TPR) were used to study the activation of Mo_2C for ethylene hydrogenation at 298 K. Mo_2C can incorporate large amounts of oxygen, and since oxygen is a poison for the reaction, it must be removed from the surface to activate the catalyst. As oxygen is removed from the surface by evacuation or reduction, it is replenished by diffusion of oxygen from the bulk. Therefore, the equivalent of several monolayers must be removed to obtain an oxygen-free surface, although it is not necessary to remove all the bulk oxygen. Furthermore, the oxygen cannot be removed by evacuation or reduction without also removing a significant amount of bulk carbon. Although the initial activity of the catalyst for ethylene hydrogenation is independent of the amount of carbon removed, the rate of deactivation of the Mo_2C strongly depends on the extent of carbon removal. As more carbon is removed, the rate of deactivation increases and the shape of the activity-time curve (deactivation curve) changes from an exponential decay to a sigmoidal shape. TPR spectra of oxygen chemisorbed on the surface after two different activation procedures showed that the surface of the catalyst depends on the extent of carbon removal. As more carbon is removed from the Mo_2C, the oxygen is bound more tightly to the surface. This suggests that ethylene also might be bound more tightly on the carbon-deficient catalyst, which is consistent with the higher rate of deactivation. 19 references.

17695 **Effect of pyridine poisoning on the kinetics of thiophene hydrogenolysis and hexene hydrogenation.** Massoth, F.E.; Miciukiewicz, J. (Univ. of Utah, Salt Lake City). *Journal of Catalysis;* **101**: No. 2, 505-514(Oct 1986).

The kinetics of deactivation of thiophene hydrodesulfurization and hexene hydrogenation by pyridine poisoning was studied in a flow microbalance reactor, which allowed simultaneous measurements of pyridine adsorption and reaction rates. The pyridine adsorption data obeyed a modified Temkin isotherm implying a distribution of adsorption sites. The deactivation kinetics could not be correlated with a reversible (rapid) pyridine adsorption model. A quasiirreversible model correlated the data very well. In this model, the rates of adsorption and desorption of pyridine are relatively slow compared to reaction rates. Thus, its effect on catalytic activity is reflected in a quasipermanent poisoning of active sites, lowering the reaction rate constant, rather than in a reversible competitive adsorption for active sites. Furthermore, it is deduced that the number of catalytically active sites is small compared to the total adsorption sites. 19 references.

17696 **Transition-state selectivity in the cracking of n-heptane over modified ZSM-5 catalysts.** Riley, M.G.; Anthony, R.G. (Texas A & M Univ., College Station). *Journal of Catalysis;* **100**: No. 2, 322-327(Aug 1986). Contract FG22-82PC51261.

The rates of cracking of n-heptane on Ni-Zn-, and H-ZSM-5 incorporated with a silica binder were in the order of Ni-ZSM-5 > Zn-ZSM-5 > H-ZSM-5. Transition state selectivity, dehydrogenation and classical carbonium ion chemistry were used to explain the relative activities of these catalysts. Activation energy for cracking of heptane over Ni-ZSM-5 was found to be 32 +/- 3 kcal/mol. 14 references.

0205 Products And By-products

REFER ALSO TO CITATION(S) 18798

0206 Health And Safety

REFER ALSO TO CITATION(S) 18305

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 17684, 17690, 18379

17697 **(CONF-870710—2) Estimating relative confidence of conditional world oil supply and demand equilibrium.** Boyd, G.A.; Hanson, D.A.; Hochheiser, H.W. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002953/JAW.

From International Association of Energy Economists conference; Calgary, Canada (6 Jul 1987).

This paper draws from the survey by the National Petroleum Council (NPC) of industry representatives and consulting/forecasting organizations on the likely market configuration under two different world oil price scenarios. The pseudo-data approach treats the forecast price and quantity variables from the various forecasts as pooled time-series, cross-sectional data, and applies traditional econometric techniques to estimate supply and demand curves. We focus on estimating US domestic supply and demand curves and respondent-specific shift factors from a subsample of the NPC survey. We find that all respondents in the survey are more confident about demand than supply forecasts. The underlying differences in indi-

vidual GNP forecasts account for much of the uncertainty in demand for most respondents, but are still 2 to 6 times more confident of demand than supply. 4 refs., 1 fig., 6 tabs.

17698 **(DOE/EI/19927—T1) Pennsylvania 1986/87 state heating oil program: [Final report].** (Pennsylvania Governor's Energy Council, Harrisburg (USA)). 30 May 1987. Contract FC01-86EI19927. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003825/JAW.

The Pennsylvania Governor's Energy Council, Bureau of Fossil Fuels, participated in the 1986/1987 State Heating Oil Program under a cooperative agreement with the US Department of Energy, Energy Information Administration (DOE/EIA). From October through May, participating dealers and distributors were surveyed for their current retail and wholesale prices of No. 2 home heating oil. Primary inventory data were also collected from select bulk terminals and refineries. This report summarizes information on Pennsylvania's home heating oil prices and inventories during the 1986/1987 heating season.

17699 **(DOE/EI/19928—T1) Wisconsin fuel oil price and inventory final report: 1986-1987 heating season.** Nichols, K.N. (Wisconsin Div. of State Energy and Coastal Management, Madison (USA)). 31 May 1987. Contract FC01-86EI19928. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003826/JAW.

In August 1986, the US Department of Energy (DOE) provided the Wisconsin Division of State Energy and Coastal Management (DSECM) a grant to monitor the price and the inventories of No. 1, and No. 2 fuel oils within the state of Wisconsin from October 6, 1986 to May 4, 1987. This grant was a renewal of the grant received in previous heating seasons with some modifications. During the 1985-1986 heating season, the inventory survey included No. 4 oil. No company in Wisconsin reported an inventory of No. 4 fuel oil during 1985-1986.and most volunteered that they had not maintained an inventory of No. 4 fuel oil for many years. This year, earlier spot inquiries showed the same absence of No. 4 oil inventories; so No. 4 oil was dropped from the inventory survey in 1986-1987. The other modifications related to improving the geographical distribution of companies surveyed and increasing the number of major suppliers from which rack price data was obtained.

17700 **(DOE/EIA—0109(87/09)) Petroleum supply monthly, September 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 24 Nov 1987. 112p. NTIS, PC A06/MF A01 - GPO; 1; GPO Dep. Order Number DE88002211/JAW.

This report presents statistical data on the sources and supplies of petroleum and petroleum products.

17701 **(DOE/EIA—0109(87/10)) Petroleum supply monthly, October 1987.** (USDOE Energy Information Administration, Washington, DC). 18 Dec 1987. 109p. NTIS, PC A06/MF A01 - GPO; 1; GPO Dep. Order Number DE88003220/JAW.

This report presents statistical data on the sources and supplies of petroleum and petroleum products. This issue contained a summary of the status of fuel oil distillates, refinery production, and the output of the Alaskan fields.

17702 **(DOE/EIA—0202(87)) Short-term energy outlook: Annual supplement, 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 11 Dec 1987. 111p. NTIS, PC A06/MF A01 - GPO; 1; GPO Dep. Order Number DE88003927/JAW.

The Energy Information Administration (EIA) publishes forecasts of short-term energy supply, demand, and prices in the Short-Term Energy Outlook (Outlook). This volume, Short-Term Energy Outlook, Annual Supplement, (Supplement) discusses major changes in the forecasting methodology, analyzes previous forecast errors, and examines current issues that affect EIA's short-term energy forecasts. The principal users of the Supplement are managers and energy analysts in private industry and government. Chapter 2 evaluates the accuracy of previous short-term energy forecasts and the major assumptions underlying these forecasts published in the last 13 issues of the Outlook. Chapter 3 compares the EIA's present energy projections with past projections and with recent projections made by other forecasting groups. Chapter 4 analyzes the 1986 increase in residual fuel oil demand after 8 consecutive years of decline. Sectoral analysis shows where and why this increase occurred. Chapter 5 discusses the methodology, estimation, and forecasts of fossil fuel shares used in the generation of electricity. Chapter 6 presents an update of the methodology used to forecast natural gas demand, with an emphasis on sectoral disaggregation. Chapter 7 compares the current use of generation data as a representation of short-term electricity demand with proposed total and sectoral sales equations. 8 refs., 7 figs., 63 tabs.

17703 **(DOE/EIA—0206(86)) Performance profiles of major energy producers, 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 26 Jan 1988. 157p. NTIS, PC A08/MF A01 - GPO; 1; GPO Dep. Order Number DE88005773/JAW.

The Energy Information Administration, through Form EIA-28, has collected financial information and other measures of energy-related business efforts and results for 22 major energy companies on a uniform, segmented basis. The merger of Cities Service with Occidental Petroleum in 1982 and the 1984 mergers of Chevron with Gulf Oil, Mobil with Superior Oil, and Texaco with Getty Oil reduced the number of reporting companies to 22 beginning with the 1985 reporting year. The comparability of information across energy lines of business is unique to this reporting system. For example, petroleum activities can be compared to activities in other energy lines of business or nonenergy areas, and domestic activities can be contrasted to foreign activities. The purpose of this publication is to examine year-to-year developments in the operations of the 22 major US energy-producing companies on a corporate level, by major line of energy business, by major functions within each line of business, and by geographic area. This report presents data collected on Form EIA-28 for the calendar year 1986. Although the focus is on developments in 1986, important trends over the 13-year period 1974 through 1986 are also featured. 26 figs., 121 tabs.

17704 **(DOE/EIA—0380(87/08)) Petroleum marketing monthly, August 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 3 Nov 1987. 168p. NTIS, PC A08/MF A01 - GPO; 1; GPO Dep. Order Number DE88002754/JAW.

Informtion and statistical data are given about a variety of crude oils and refined petroleum products. The publication provides crude oil cost statistics and refined petroleum products sales statistics for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase price, the f.o.b. and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented.

17705 **(DOE/EIA—0380(87/09)) Petroleum marketing monthly, September 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 30 Nov 1987. 172p. NTIS, PC A08/MF A01 - GPO; 1; GPO Dep. Order Number DE88003329/JAW.

Information and statistical data are given about a variety of crude oils and refined petroleum products. The publication provides crude oil cost statistics and refined petroleum products sales statistics for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase price, the f.o.b. and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented.

17706 **(DOE/EIA—0380(87/10)) Petroleum marketing monthly, October 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 31 Dec 1987. 166p. NTIS, PC A08/MF A01 - GPO; 1; GPO Dep. Order Number DE88004798/JAW.

Information and statistical data are given about a variety of crude oils and refined petroleum products. The publication pro-

vides crude oil cost statistics and refined petroleum products sales statistics for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase price, the f.o.b. and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented.

17707 **(DOE/EIA—0487(86)) Petroleum marketing annual, 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 31 Dec 1987. 362p. NTIS, PC A16/MF A01 - GPO; 1; GPO Dep. Order Number DE88004760/JAW.

Information and statistical data are given about a variety of crude oils and refined petroleum products. The publication provides crude oil cost statistics and refined petroleum products sales statistics for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase price, the f.o.b. and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented.

17708 **(OPEC—8900368) OPEC [Organization of the Petroleum Exporting Countries] Annual Statistical Bulletin, 1986.** (Organization of the Petroleum Exporting Countries, Vienna (Austria). Secretariat). 1986. 166p. NTIS, PC A08. Order Number DE88900368/JAW.

This issue of the Annual Statistical Bulletin clearly documents, in tables and graphs, the turbulence which characterized the oil market in 1986. Of course, the picture was not entirely one of gloom. The events of 1986 ensured a higher production level for OPEC Member Countries that year than in the previous year, when OPEC production fell to 15.4 million barrels a day. Despite this increase in production there was a noticeable rise in OPEC's petroleum reserves which reached 644.5 billion barrels, thus bringing the Organization's share to almost three-quarters of total world oil reserves. This rise in OPEC reserves took place despite the collapse in prices and the 18% fall in drilling activities in OPEC Member Countries in 1986 compared to 1985, thus underscoring the fact that the possibilities of finding new oil in OPEC Member Countries are greater than elsewhere. Little or no change was registered during the year in OPEC's production and consumption of refined products: these stood at five million and 3.1 million barrels per day, respectively. OPEC also improved its natural gas position, with 1986 proven reserves amounting to 40,633 thousand million cubic metres. They marketed 52% of their 1986 production which stood at 172,413 million cubic metres. 75 tabs.

0208 Waste Management

REFER ALSO TO CITATION(S) 18923, 18924, 19351

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 17676, 17677, 17686, 19295, 19296, 19307

17709 **(EGG—10282-2177) Characteristics of dens used by radiocollared San Joaquin kit fox, Vulpes macrotis mutica, Naval Petroleum Reserve No. 1, Kern County, California.** Berry, W.H.; O'Farrell, T.P.; Kato, T.T.; McCue, P.M. (EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations). Aug 1987. Contract AC08-83NV10282. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003548/JAW.

A total of 946 dens used by radiocollared San Joaquin kit foxes, Vulpes macrotis mutica, were observed on Naval Petroleum Reserve No. 1 and surrounding lands in Kern County, California. Of these, 887 were typical subterranean dens located in 65 sections, and 59 were atypical dens in man-made structures located in 24 sections and in two pipe storage yards. Although the number of entrances to dens ranged between 1 and 17, most (90%) had six or fewer entrances and the average, which did not differ between developed and undeveloped habitats, was 3.4. Entrances were significantly higher than wide, and 53% had ramp-shaped dirt berms. Dens had an average slope angle of 16.1° and more were found on slopes than in flats. Fewer dens faced the northwest quadrant and more faced the southern quadrant than expected. Evidence of kit foxes (tracks, scats, or prey remains) was observed at 80% of the dens, but 11% were not associated with kit fox sign (matted vegetation or trails) even though they were occupied. Human disturbances, most frequently roads, were observed in the immediate vicinity of 78% of the dens. Most (93%) atypical dens were in metal pipes, three were in buried wooden culverts, and one was under a concrete slab. 27 refs., 7 figs., 10 tabs.

17710 **(NIPER—274) Groundwater contamination from refinery operations: Final report.** Wells, J.; Brinkman, D.; Stirling, K.Q. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Jan 1988. Contract FC22-83FE60149. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001210/JAW.

The objective of this research project has been to evaluate the problems of groundwater contamination which are attributable to refining operations and to produce a model that will describe the transport of the hydrocarbon phase through the unsaturated zone to the capillary zone and predict the extent of spreading and the contamination of the groundwater via solution. This final report describes the development of a mathematical model for the simulation of immiscible flow through the unsaturated zone. This information is essential to the US Department of Energy in its mission to assure a reliable, affordable, and environmentally acceptable supply of energy that is compatible with the national goals of security, economic well-being, and protection of health and safety. 33 refs., 5 figs., 1 tab.

17711 **(OCS/EIS/EA/MMS—87-0110-Vol.2) Chukchi Sea Oil and Lease Sale 109: Alaska Outer Continental Shelf: Final Environmental Impact Statement, Volume 2.** (Minerals Management Service, Anchorage, AK (USA). Alaska Outer Continental Shelf Region). Nov 1987. 400p. Minerals Management Service, P.O. Box 101159, Anchorage, AK 99510. Order Number TI88900200/JAW.

This volume contains reproductions of all letters received in comment to the DEIS and substantive excerpts from oral testimony given during the five public hearings. Specific comments are bracketed, and responses follow the comments. Approximately 560 individual comments received a response. Where comments warranted changes in the text of the EIS or presented new, substantive information, the EIS was revised accordingly. Reference to the revised sections is made in the responses to specific comments.

17712 **(PB—88-122486/XAB) Oil-spill risk analysis, northern California (Proposed Sale 91) Outer Continental Shelf.** Anderson, C.M.; Notario, J.J.; LaBelle, R.P.; Lucas, A.D. (Minerals Management Service, Los Angeles, CA (USA). Pacific OCS Region). Aug 1987. 123p. (MMS—87/0085). NTIS, PC A06/MF A01.

Contents include: summary of the proposed action and cumulative case; environmental resources; estimated oil resources; probability of oil spills occurring; oil-spill trajectory simulations; combined analysis of oil-spill occurrence and oil-spill trajectory simulations; and discussion and conclusions.

0210 Legislation And Regulation

REFER ALSO TO CITATION(S) 17716

17713 **(MMM—8900202) Leasing energy resources on the Outer Continental Shelf.** (Minerals Management Service, Washington, DC (USA)). 31 Jul 1987. 54p. Offshore Minerals Management, MS 645, Minerals Management Service, Washington, DC 20240. Order Number TI88900202/JAW.

This booklet provides a basic review of the leasing process for oil and gas on the Federal Outer Continental Shelf. In the 33 years since leasing was first authorized in 1953, more than 84 billion dollars in revenues have been generated, and in that time many changes have occurred in the leasing process. While virtually each of 89 lease sales held between 1953 and 1986 had individual charac-

teristics, leasing has settled into a stable process with certain standardized steps covering a time period of two or more years for each sale. Federal Outer Continental Shelf leases exist off all coasts. Of 5068 leases in existence at the end of 1986, 83% were in the Gulf of Mexico, 12% were off Alaska, 3% were off the Pacific coast, and 2% were off the Atlantic coast. While exploration and leasing activity slowed in 1986 due to declining oil prices, the contribution that Federal offshore leasing makes to the national energy picture is substantial. About one-eighth of the nation's domestic oil production comes from Federal waters as does about one-quarter of its natural gas. Because of the long lead times involved from leasing to exploration to production, it is essential that sound leasing policies continue. 20 refs., 23 figs.

17714 **An engineering perspective of the promulgation and application of West Virginia's new rules and regulations for the oil and gas industry.** Johnston, J.H.; Streit, T.M. (West Virginia Dept. of Energy). pp 13-20 of Proceedings of the SPE Eastern regional meeting. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-8710205—).

From Society of Petroleum Engineers Eastern Regional meeting; Champion, PA, USA (21 Oct 1987).

Technical Paper SPE 17027.

The West Virginia Legislature created the West Virginia Department of Energy in April, 1985, by amending Chapter 22 of the West Virginia Code. This "Energy Act" empowered the Division of Oil and Gas of the Department of Energy to be responsible for all matters pertaining to the extraction of oil and gas resources. Previously, the oil and gas industry had been regulated by several state agencies and the creation of this Department made possible what was termed "one-stop shopping". This concept allows an operator to receive all required permits from one agency and effectively consolidates the regulation of the industry under one agency. New rules and regulations that correspond to the "Energy Act" were necessary to effectively administer the duties mandated by law. New regulations governing hazardous waste, solid waste, water discharge permits, and underground injection were required in addition to modification of the Department of Mines regulations dealing with oil and gas such as casing and reclamation. Eight series of Rules and Regulations were adopted by the 1987 Legislature to fulfill the requirements created by passage of the "Energy Act". This paper describes: 1) How the Rules came to be written and how they passed through various hearings and committees prior to being enacted, 2) what purpose they have in the overall scheme of "one-stop shopping", and 3) the application of the rules and regulations in practice and what effect they have on a typical West Virginia operation.

0230 Properties

REFER ALSO TO CITATION(S) 17687, 18722

17715 **(NIPER—289) Analysis of heavy oils: Method development and application to Cerro Negro heavy petroleum: Topical report.** Pearson, C.D.; Green, J.A.; Green, J.B. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Jan 1988. Contract FC22-83FE60149. 26p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88001215/JAW.

Nickel, vanadium, and iron were determined in distilled and chromatographically separated fractions from Cerro Negro heavy petroleum. Corresponding data were also obtained on two samples of Wilmington, California, heavy crude and one Mayan, Mexico, heavy oil for comparison. For the Cerro Negro crude, the ratio of porphyrinic to nonporphyrinic forms of metals was also determined on selected fractions using visible spectroscopy. In all four heavy petroleums, significant levels of metals were found only in the highest boiling distillate available, ca. 550-700°C (1000-1300°F), and the residue. Typically, the distillation residue contained >95 percent of a given metal. All crudes contained metalloorganics of the following types: strongly acidic, weakly acidic, strongly basic, weakly basic, and neutral, but the relative distribution of metals among each class was crude dependent. Generally, nickel and vanadium distributions for a given crude followed one another very closely, while those for iron were often inconclusive because of poor mass balances for that element. Attempts to concentrate metalloorganics through liquid chromatographic separation methods largely unsuccessful. The wide variety of types of metal-containing compounds in the crudes examined precluded the use of a single approach for their isolation or preconcentration. 21 refs., 1 fig., 12 tabs.

0240 Storage

17716 **(EPRI-CS—5520) Trends in state and local underground storage tank regulations: Final report.** (Weston (Roy F.), Inc., Concord, CA (USA)). Dec 1987. 181p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920109/JAW.

This six chapter report presents an analysis of state and federal regulations governing underground storage tanks (UST) for petroleum and chemical products. Contained in the appendix are fact sheets for each state and the District of Columbia describing the UST regulations as of June 1987. Both the state and federal level regulations are constantly evolving in order to respond to increased emphasis on environmental protection concerns as opposed to fire safety concerns. It is therefore suggested that the state agency responsible for implementation of UST programs be contacted to obtain current information when making regulatory compliance and/or financial decisions concerning UST's. 2 figs., 9 tabs.

17717 **(SAND—87-2365) 3-D finite element calculation of subsidence induced deformation of the Weeks Island Service Shaft.** Preece, D.S. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1987. Contract AC04-76DP00789. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005509/JAW.

The Service Shaft at the Weeks Island SPR facility has experienced vertical and lateral movement since it was constructed in 1905. Movement of the shaft over the past few years has been confirmed through survey levels of the shaft collar and two plumbline surveys of the top 100 feet of the shaft. This 3-D finite element calculation was done to gain an understanding of the deformation of the Service Shaft due to the subsidence of the surrounding material. Subsidence at the site results from creep closure of the bi-level room-and-pillar salt mine which is currently the reservoir for 73 million-barrels of crude oil. The 3-D finite element model treats the southwest corner of the mine and contains 118 pillars on two levels of the mine. The deformation of the Service Shaft is determined from the displacement of a vertical line of nodes in the model which is assumed to be the axis of the Service Shaft. The calculation shows that the Service Shaft is tilting to the northeast and moving downward. The movement, however, is mostly a rigid body rotation and translation with very slight bending and stretching of the shaft. Because the bending and tensile strains are insignificant, this calculation indicates that rupture of the shaft is unlikely. 23 refs., 17 figs., 2 tabs.

03 NATURAL GAS

0301 Reserves

REFER ALSO TO CITATION(S) 17674

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 17675, 17676, 17677, 17726

17718 **(DOE/METC—87/6080) Proceedings of the unconventional gas recovery contractors review meeting.** Komar, C.A. (ed.). (USDOE Morgantown Energy Technology Center, WV). Jul 1987. 512p. (CONF-870728—). NTIS, PC A22/MF A01; 1; GPO Dep. Order Number DE87006490/JAW.

From Unconventional gas recovery and utilization; Morgantown, WV, USA (28 Jul 1987).

This document contains papers that were presented at the Department of Energy's contract review meeting on Eastern Gas Shales, Western Gas Sands, Deep Source Gas, Gas Hydrates, and

Arctic/Offshore Research, which was hosted by the Morgantown Energy Technology Center on July 28 and 29, 1987, at the Sheraton Lakeview Conference Center, in Morgantown, West Virginia. The objectives of this conference were the following: to review the current status in various research activities; and to promote technical information exchange among researchers. One hundred seventy-five registrants from academia, industry, and national laboratories joined contractors and DOE researchers in attendance. Fifty-four presentations, a general session, and a poster session covering the Unconventional Gas Recovery program and related activities in geoscience, reservoir science, and physical/chemical science were included in the 2-day meeting. Selected papers have been processed for inclusion in the Energy Data Base.

17710 **Data base for eastern gas-bearing formations: Development and application.** Ameri, S.; Aminian, K.; Yost, A.B. II. (West Virginia Univ.). pp 371-380 of Proceedings of the SPE Eastern regional meeting. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-8710205—).

From Society of Petroleum Engineers Eastern Regional meeting; Champion, PA, USA (21 Oct 1987).

Technical Paper SPE 17065.

The Appalachian Basin contains a number of low permeability formations which have produced natural gas for many years. The lack of reliable data/information pertaining to parameters controlling production of natural gas from such low permeability (tight) gas bearing formations has hindered their continuous economic development. The data that have been available usually consisted of isolated data points held within the company files without a mechanism for comparison with other similar formation(s) in the Appalachian Basin. This has effectively prohibited the development of any kind of statistically base from which one might infer the production mechanism, predict performance, determine the responsiveness of formations to stimulation treatments, and delineate the high potential areas of future development. The overall goal of this study is directed towards answering some of the questions needed to help the eastern low permeability formations become viable candidates for future development. This research project endeavers to solve the problem, at least for a subset of the tight gas bearing formations consisting of Big Injun, Berea, Benson, Oriskany, Big Six and Tuscarora that exist in the Appalachian Basin.

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 17686, 17688, 17719, 17725

17720 **Predicting gas well performance under altered conditions.** Aminian, K.; Ameri, S.; Beg, N.; Yost, A.B. II. (West Virginia Univ.). pp 323-332 of Proceedings of the SPE Eastern regional meeting. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-8710205—).

From Society of Petroleum Engineers Eastern Regional meeting; Champion, PA, USA (21 Oct 1987).

Technical Paper SPE 17060.

Forecasting production rates from gas wells has always been of considerable importance to the natural gas industry. The conventional method of predicting the performance of gas reservoirs requires data which are often unavailable. This is particularly the case when dealing with low permeability gas reservoirs. In the absence of complete reservoir data, the production decline type curves are employed to predict the future rates utilizing production history. Generally, the production decline type curves are generated based on assumption that the operating and reservoir conditions which affected gas production in the past will remain unchanged. However, there are many instances when it is necessary to forecast the production rates under conditions which are not similar to those of the past. Typical examples of such cases are: (a) changes encountered in well spacing due to developmental drilling programs and (b) backpressure changes which occur due to compressor installations. This paper introduces a series of production decline type curves and relative methodologies which can be utilized to forecast gas production when the conditions are altered. A gas reservoir model has been utilized to simulate gas production to study the effects of changes relative to reservoir and operating conditions. The model takes into account many factors such as the non-Darcy flow effects, skin factor, and pressure dependent gas properties. The results have been utilized to develop techniques (for type curve applications) to forecast production under different reservoir and operating conditions.

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 17702, 17708, 17731, 18379

17721 **(DOE/EIA—0130-87/11) Natural gas monthly, November 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 29 Jan 1988. 134p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. Order Number DE88005774/JAW.

This report highlights activities, events, and analyses of interest to public and private sector organizations associated with the natural gas industry. Volume and price data are presented each month for natural gas production, distribution, consumption, and interstate pipeline activities. Producer related activities and underground storage data are also reported. The data in this publication are collected on surveys conducted by the Energy Information Administration (EIA), of the Department to fulfill its responsibilities for gathering and reporting energy data. Some of the data are collected under the authority of the Federal Energy Regulatory Commission (FERC), an independent commission within the DOE, which has jurisdiction primarily in the regulation of electric utilities and the interstate natural gas industry. 6 refs., 6 figs., 33 tabs.

17722 **(DOE/EIA—0167(86)) Gas supplies of interstate natural gas pipeline companies, 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 18 Dec 1987. 126p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. Order Number DE88004123/JAW.

The publication provides information on the total reserves, production, and deliverability capabilities of the 90 interstate pipeline companies. The gas supplies of interstate pipeline companies consist of the certificated, dedicated, recoverable, salable natural gas available from domestic in-the-ground reserves; gas purchased under contracts with other interstate pipeline companies; domestically produced coal gas, liquefied natural gas (LNG), and synthetic natural gas (SNG); and imported natural gas and LNG. The domestic in-the-ground reserves consist of company-owned reserves including natural gas in underground storage, reserves dedicated to or warranted under contracts with independent producers, and supplemental or short-term supplies purchased from independent producers and intrastate pipeline companies. To avoid duplicate reporting of domestic in-the-ground reserves, the volumes of gas under contract agreement between jurisdictional pipelines have been excluded in summarizing State and national reserves. Volumes contracted under agreements with foreign suppliers include pipeline imports from Canada and Mexico. 7 figs., 18 tabs.

0307 Waste Management

REFER ALSO TO CITATION(S) 17703

0308 Environmental Aspects

REFER ALSO TO CITATION(S) 17676, 17677, 17686, 17726, 17732, 19114, 19307

17723 **(CONF-8710210—2) Erosion control on steep slopes following pipeline construction.** Zellmer, S.D.; Taylor, J.D.; Conte, D.J.; Gaynor, A.J. (Argonne National Lab., IL (USA); California Univ. of Pennsylvania (USA); Gas Research Inst., Chicago, IL (USA)). 1987. Contract W-31109-ENG-38. 13p. NTIS, PC A03. Order Number DE88002882/JAW.

From 4. symposium on environmental concerns in rights-of-way management; Indianapolis, IN, USA (25 Oct 1987).

Replicated plots to compare the effectiveness of eight erosion-control methods, representing a wide range of economic cost, were established during cleanup operations over the pipeline and on the working side of an ROW on a 23% slope in southwestern

Pennsylvania. Precipitation, runoff volume, and sediment yield were determined for 45 precipitation events, and vegetative cover was measured by the point-intercept method four times during the 18-month study. Differences in sediment yield were observed between eight erosion-control methods tested and their ROW locations, but total plant cover was not influenced by method or location. The combination of material and installation costs for each method was estimated. Combined economic and environmental data indicated straw mulch at 3.35 Mg ha^{-1} (1.5 ton $acre^{-1}$) was the most effective of the methods tested. 9 refs., 6 tabs.

17724 **(CONF-8710210—4) Effects on suspended and substrate sediments in two streams resulting from different gas-pipeline installation techniques.** Schubert, J.P.; Vinikour, W.S. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 12p. NTIS, PC A03. Order Number DE88002877/JAW.

From 4. symposium on environmental concerns in rights-of-way management; Indianapolis, IN, USA (25 Oct 1987).

The effects of gas-pipeline construction projects on suspended solids (SS) and streambed sediments were investigated at two stream sites. The Little Miami River in Ohio was crossed using the wet-ditching technique. Concentrations of SS were elevated up to 400 m downstream during the two days of trenching operations, and fine sediment was deposited on the streambed up to 200 m downstream of the crossing. The SS decreased rapidly after trenching was completed, and the fine sediment was removed from the streambed by high stream flows two to eight months after construction. Canada Creek in Michigan was crossed using a plow method. The time duration of stream disturbance was much less for the plow method, and the effects on suspended solids and streambed sedimentation were minimal. For both installation methods, the impacts were reversible, and no long-term impacts on the stream environments were detectable. 24 refs., 10 figs., 1 tab.

0309 Artificial Stimulation

REFER ALSO TO CITATION(S) 17718

17725 **Estimation of parameters for drilling in Arctic and offshore environment in the presence of hydrates.** Roadifer, R.D.; Godbole, S.P.; Kamath, V.A. (Univ. of Alaska). pp 193-206 of Proceedings of the 1987 SPE annual technical conference and exhibition: Drilling. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870913—).

From Annual technical conference and exhibition of the Society of Petroleum Engineers; Dallas, TX, USA (27 Sep 1987).

Technical Paper SPE 16671.

Currently, two different methods are used to drill through hydrate containing formations. Predominately, cool drilling fluid with higher mud weight at high circulation rates is used to slow or prevent hydrate dissociation in the formation. Panarctic Oils Ltd., alternatively, tries to promote the dissociation at early times while the drill pipe is in the hole by using low weight muds with proper degassing equipment at the surface (Franklin, 1980). A thermal simulator developed earlier is modified to model the dissociation of hydrates under a wide range of drilling conditions. Major new features include the coupling of wellbore heat transfer and hydraulics with the hydrate dissociation model. Well configuration and makeup are user specified and included in the wellbore calculations. Either arctic or subsea locations and corresponding geothermal and pressure gradients may be specified. For arctic regions, the melting of permafrost may be modeled concurrently with the hydrate dissociation. The results are presented in a series of nomograms and plots for both arctic and subsea hydrate locations. These nomograms can be used quickly and easily to determine drilling parameters required to keep hydrate dissociation within the limits of the surface gas equipment, or alternatively, given the drilling fluid parameters, design criteria for the surface equipment can be established.

17726 **Drilling a 2,000-ft horizontal well in the Devonian Shale.** Yost, A.B. II; Overbey, W.K.; Carden, R.S. (U.S. DOE/METC). pp 291-302 of Proceedings of the 1987 SPE annual technical conference and exhibition: Drilling. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-870913—).

From Annual technical conference and exhibition of the Society of Petroleum Engineers; Dallas, TX, USA (27 Sep 1987).

Technical Paper SPE 16681.

This paper discusses drilling a 2,000-foot horizontal well in the Devonian Shale, Wayne County, West Virginia, to test the concept that multiple hydraulic fractures from a horizontal wellbore can increase gas recovery efficiency over vertical stimulated boreholes. Discussion focuses on the air/mist drilling, wireline probes, and bottomhole assemblies that were used to drill the well. The target was a 50-foot zone located at a depth of 3,400 feet. Total hole length was 6,020 feet. The angle-building section was achieved using a 4.25°/100-foot design to reduce the risks associated with casing installation in the horizontal section. Directional control methods proved to be unreliable in an air-drilling environment. Bottomhole assembly performance was heavily dependent on motor life and lithologic type. The completion program for the well consisted of installation of 4 1/2-inch casing with external casing packers and port collars. This completion string was installed in 2,000 feet of open hole section that was air drilled. Both geophysical well logs and a borehole television camera survey were used to design the casing string so that shale intervals could be isolated for testing and evaluation before and after stimulation.

0310 Legislation And Regulation

REFER ALSO TO CITATION(S) 17713, 17714

0320 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 17722, 17724

17727 **(PB—88-150099/XAB) Optical self-sensing for interior gas distribution. Final report, March 1987-August 1987.** Euliss, G.W.; Lawson, C.M. (BDM Corp., McLean, VA (USA)). Dec 1987. 87p. NTIS, PC A05/MF A01.

A novel concept for the distribution of natural gas in residential and commercial structures was prototyped and demonstrated. The concept is based upon the use of Nylon 11 pipe incorporated with an optical-fiber sensing element to detect physical conditions that threaten to cause damage to the piping system. The prototype was tested under the influence of puncturing objects, crushing forces, impact, and high temperatures. In each case, the ability to detect these conditions prior to serious damage was successfully demonstrated.

17728 **(PB—88-150107/XAB) Prototype development plan for a robot which will investigate the condition of underground pipe. Topical report, February-September 1987.** Coose, J.P.; Firey, B.M.; Hudson, F.W.; Zinsmeyer, C.D. (BDM Corp., McLean, VA (USA)). Dec 1987. 40p. NTIS, PC A03/MF A01.

The feasibility of a robotic device to operate within underground gas-distribution pipe systems and investigate the condition of the pipe is considered. The device is defined to consist of seven subsystems; locomotion, steering and articulation, power, navigation, inspection, communication, and control. The robot is found to present major challenges in robotic control, miniaturized packaging, and autonomous navigation; it appears that these difficulties are surmountable with present-day technology. A prototype development plan was developed, providing for a phased approach to first produce a tethered pipe crawler and culminate in the fully autonomous mouse.

17729 **Hydrocarbon transportation fuels from biomass: An overview of thermal conversion research sponsored by U.S. Department of Energy.** Stevens, D.J. (Pacific Northwest Lab., P.O. Box 999, Richland, WA 99352). pp 936-940 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—). Contract AC06-76RL01830.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879006.

Biomass is an important energy resource at present and offers excellent potential for increased energy impact in the future. This potential energy impact is expected to be met in part by liquid transportation fuels derived from biomass. Liquid fuels are more energy dense than biomass itself and more closely match existing end-use patterns. In this paper, research sponsored by the U.S. Department of Energy's Biofuels and Municipal Waste Technology Division on the production of liquid hydrocarbon fuels from biomass is discussed. These fuels are generated by first converting the biomass resource to biocrude oils and then upgrading those to hydrocarbon products. An overview of the ongoing research program is presented.

17730 **(BG-Trans—08695) Control of a gas distribution system dynamic simulation of the transmission system.** Kralik, J.; Stiegler, P.; Vostry, Z.; Zavorka, J. Translated from *Automatizace ;* **29**: No. 4, 100-103(1986). 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87901000/JAW.

In this article, the authors describe the results of calculating the dynamics of the flow of gas through the selected section of a transmission pipeline. They present examples indicating the accuracy of the equations derived for calculating the working point of the compressor plant with turbocompressors and describe operation with the SIMONE program package which makes it possible to simulate phenomena taking place in the most complicated pipeline networks and branches even in small computers. 11 refs., 7 figs.

0330 Properties

REFER ALSO TO CITATION(S) 19682

0340 Combustion

REFER ALSO TO CITATION(S) 18448

17731 **(PB—88-145362/XAB) Development of a high-temperature indirect gas-fired furnace. Topical report, March 1986-July 1987.** Kuhn, T.J. (Midland-Ross Corp., Toledo, OH (USA)). 6 Aug 1987. 101p. (REPT—1332). NTIS, PC A06/MF A01.

Natural gas has potential to become a lower-cost energy alternative to electric resistance heating for process temperatures above 1800 F in controlled-atmosphere furnaces. The program is intended to develop advanced features in an indirect gas-fired intergal quench furnace used in the metals heat-treat industry. Engineering design and testing produced an advanced high temperature radiant-tube heating system with greatly increased heat input, operating temperatures up to 2050 F and thermal efficiency over 70%. An advanced hearth was also developed to increase the weight of heat treated work that could be handled in each batch. These major improvements are expected to increase the productivity operation. A total furnace design was completed and released for construction of a prototype gas-fired integral quench furnace. The furnace improvements developed in the program will benefit the operation of all gas-fired furnaces using radiant tubes and operating up to 2050 F.

0350 Storage

17732 **(NP—8770041) Frost susceptibility of soils around an LNG inground storage tank.** Kataoka, Tetsuyuki; Ogata, Nobuhide. (Central Research Inst. of Electric Power Industry, Abiko, Chiba (Japan)). Jan 1987. 37p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88770041/JAW.

The growth of frozen zone in the soil creates pressure which acts on the tank wall, and heaving of both of the tank and of the surrounding ground. The earth pressure and frost heaving of the tank are a serious problem for the stability of the LNG inground tank. This paper describes the results of frost heaving tests which were conducted to propose a simplified evaluation method of the amount of frost heaving of soils. The soils used for the tests are undisturbed samples and prepared samples which have various grading curves. The results have proved to help estimate the amount of frost heave. (31 figs, 2 tabs)

17733 **(PB—88-150073/XAB) Development of improved technologies and techniques for reducing base gas requirements in underground natural gas storage facilities. Mathematical model. Final report, July 1986-September 1987.** Modine, A.D.; Bashbush, J.L. (Scientific Software-Intercomp, Inc., Denver, CO (USA)). Dec 1987. 138p. NTIS, PC A07/MF A01.

Base gas requirements in the U.S. amount to a few trillion cubic feet. The Gas Research Institute has proposed a gas-storage operating plan whereby an inert gas or a low-BTU gas could be injected to replace part of the hydrocarbon gas. A reservoir simulator was developed to solve gas-water reservoir problems where the gas may be treated as a two-component miscible mixture. The simulator is based on a modification of SSI's standard 3-phase, 3-dimensional reservoir simulator and, therefore, it encompasses the experience of more than 20 years of simulation technology. To accomplish the task, the oil equation was removed and a means of tracking a second component (inert) in the gas phase was added. The movement of the inert component was described with the method of characteristics to practically eliminate the numerical dispersion problems associated with the solution of the flow equations with standard finite-difference methods.

04 OIL SHALES AND TAR SANDS

17734 **(DOE/LC/11054—2444) Transfer of oil shale research data into the Morgantown Energy Technology Center data base.** Merriam, N.W. (Western Research Inst., Laramie, WY (USA)). Sep 1987. Contract AC21-85LC11054. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004698/JAW.

The US Department of Energy (DOE), Morgantown Energy Technology Center constructed a fossil energy research data base to make data readily available to the public, to avoid duplication of research, to guide future research, and to reduce costs of future research. Western Research Institute (WRI) was awarded a contract to put data from work done prior to 1983 into the data base. Most of the data that WRI transferred to DOE on magnetic tape was oil shale data because the underground coal gasification (UCG) data base was not ready to receive data until late in the contract period. The high cost of processing data in the manner specified prevented all of the highly ranked data from being transferred with available funding. One hundred and ten sets of data were transferred to DOE on magnetic tape: ninety-three sets of oil shale data and two sets of UCG data to the test data data base, and fifteen sets of oil shale data including assay, mineralogy, and lithology data from 12,907 samples using 7,972,404 computer words to the resource extraction data base. Two thousand and seventy sets of data were microfiched and transferred to DOE; these included 1111 sets of oil shale data, 211 sets of tar sands data, 195 sets of UCG data, and 216 sets of environmental data. Three recommendations are made for reducing the cost of transferring data into the data base: (1) eliminate the use of data input forms, (2) eliminate the waiting time between responses from the computer, and (3) keep the data base updated. 3 refs., 1 fig., 2 tabs.

0402 Site Geology And Hydrology

17735 **(DOE/MC/11076—2442) An evaluation of baseline conditions at lease tract C-a, Rio Blanco County, Colorado.** Barteaux, W.L.; Biezugbe, G. (Western Research Inst., Laramie, WY (USA)). Sep 1987. Contract FC21-86MC11076. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004169/JAW.

An analysis was made of baseline groundwater quality data from oil shale lease tract C-a, managed by Rio Blanco Oil Shale Company. The data are limited in several respects. All conclusions drawn from the data must be qualified with these limitations. Baseline conditions were determined by analyzing data from wells in the upper bedrock and lower bedrock aquifers and from the alluvial wells. Baseline data were considered all data collected before

mining operations began. The water quality was then evaluated using the 1987 Colorado State Basic Standards for Ground Water as a basis. The maximum baseline values for several parameters in each aquifer exceed the standard values. The quality of the upper lower bedrock aquifers varies from region to region within the site. Data on the lower bedrock aquifer are insufficient for speculation on the cause of the variations. Variations in the upper bedrock aquifer are possibly caused by leakage of the lower bedrock aquifer. 16 refs., 9 figs., 9 tabs.

0403 Drilling, Fracturing, And Mining

REFER ALSO TO CITATION(S) 19758

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 17526

17736 **Gas storage and transport in the Devonian shales.** Schettler, P.D.; Parmely, C.R.; Lee, W.J. (Juniata College). pp 415-424 of Proceedings of the SPE Eastern regional meeting. Richardson, TX; Society of Petroleum Engineers (1987). (CONF-8710205—).

From Society of Petroleum Engineers Eastern Regional meeting; Champion, PA, USA (21 Oct 1987).

Technical Paper SPE 17070.

There has been recent interest in applying dual-porosity reservoir simulators to the analysis of production data in the Devonian Shales. In a dual-porosity model, gas is stored in the rock matrix, while production occurs through a network of naturally occurring factures which intersects the wellbore. This paper presents the results of degassing experiments performed on Devonian Shale core samples to identify the storage capacity and fluid flow characteristics of the Devonian Shale matrix.

17737 **(UCID—21124) Clay-induced oil loss and alkene isomerization during oil shale retorting.** Taylor, R.W.; Curry, K.; Oh, M.S.; Coburn, T. (Lawrence Livermore National Lab., CA (USA)). Apr 1987. Contract W-7405-ENG-48. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005503/JAW.

Oil shale from the Green River formation in Colorado was mixed with nearly an equal weight of clay and retorted under conditions similar to Fischer assay. The amount of oil collected decreased approximately 18% when the clay added was montmorillonite. The amout of oil lost was independent of the degree of dehydration of the clay, and the preence of this clay did not change the ratio of saturated to unsaturated linear hydrocarbons for mid to heavy oil fractions. When dehydrated kaolinite was added there was no significant loss of oil yield, but the oil produced showed a decrease by a factor of 2 in the ratio of 1-alkenes to n-alkanes. When partly dehydrated or raw kaolinite was used, the apparent loss of 1-alkenes was not as great. This ratio change is due to a migration of the double bond from the 1-alkene position to internal positions, according to NMR. This explanation for the ratio change is also suggested by the decrease in concentration of prist-1-ene with respect to prist-2-ene when retorting is done with shale premixed with kaolinite. 35 refs., 13 figs., 4 tabs.

17738 **(UCRL—97677) Variable temperature pyrolysis of domestic tar sands: Asphalt Ridge (Utah) and Big Clifty (Kentucky).** Reynolds, J.G.; Crawford, R.W.; Coburn, T.T. (Lawrence Livermore National Lab., CA (USA)). Nov 1987. Contract W-7405-ENG-48. 35p. (CONF-871198—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004714/JAW.

From Eastern oil shale symposium; Lexington, KY, USA (18 Nov 1987).

Asphalt Ridge (Utah) and Big Clifty (Kentucky) tar sands were subjected to programmed temperature pyrolysis and the volatile products were detected by tandem on-line mass spectrometry (MS/MS) in real time analyses. A heating rate of 4°C/min from room temperature to 900°C was employed. Evolution of hydrogen, light hydrocarbons, nitrogen-, sulfur- and oxygen-containing compounds was monitored by MS or MS/MS detection. Evolution of volatile organic compounds occurred primarily in two regimes: (1) low temperature (maximum evolution at 150 to 175°C), corresponding to entrained organics, and (2) high temperature (maximum evolution at 440 to 460°C), corresponding to cracking of large organic components. For both tar sands, the pyrolysis yields were dominated by the evolution of light hydrocarbons. Alkanes and alkenes of two carbons and higher had temperatures of maximum evolution at approximately 445°C, and methane at approximately 460°C. Aromatic hydrocarbons had temperatures of maximum evolution at approximately 440°C. The principal differences between the two tar sands were observed in the behavior of hydrocarbon evolution. The Big Clifty tar sand evolved much more entrained organics and had slightly lower temperatures of maximum evolution than the Asphalt Ridge tar sand. In general, the noncondensible gases, H_2, CO, and CO_2, exhibited evolution associated with hydrocarbon cracking reactions, and high temperature evolution associated with mineral decomposition, the water-gas shift reaction, and gasification reactions. 29 refs., 7 figs., 2 tabs.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 17738

17739 **(UCRL—97681) Enthalpy relations for Eastern oil shales.** Camp, D.W. (Lawrence Livermore National Lab., CA (USA)). Nov 1987. Contract W-7405-ENG-48. 12p. (CONF-871198—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004398/JAW.

From Eastern oil shale symposium; Lexington, KY, USA (18 Nov 1987).

Relations were developed that allow easy and accurate calculation of enthalpy changes during the heating, retorting, or cooling of raw, spent, or burned Eastern oil shales. The heat capacities of the mineral matter, bound water, kerogen, and char, and the heat of mineral dehydration are given by linear or quadratic functions of temperature. Values are recommended for the heats of kerogen pyrolysis and pyrite decomposition. A relation was developed for estimating the extent of mineral dehydration as a function of temperature. Predictions made using these relations agree with all available Eastern shale data. 36 refs., 6 figs., 3 tabs.

0410 Environmental Aspects

REFER ALSO TO CITATION(S) 17735

05 NUCLEAR FUELS

0501 Reserves, Exploration, And Mining

17740 **(IAEA-TECDOC—427) Uranium deposits in Proterozoic quartz-pebble conglomerates. Report of the Working Group on Uranium Geology.** (International Atomic Energy Agency, Vienna (Austria)). Sep 1987. 459p. NTIS (US Sales Only), PC A20/MF A01. Order Number TI88701433/JAW.

This report is the result of an effort to gather together the most important information on uranium deposits in Proterozoic quartz-pebble conglomerates in the United States of America, Canada, Finland, Ghana, South Africa and Australia. The paper discusses the uranium potential (and in some cases also the gold potential in South Africa, Western Australia and Ghana) in terms of ores, sedimentation, mineralization, metamorphism, placers, geologic formations, stratigraphy, petrology, exploration, tectonics and distribution. Geologic history and application of geologic models are also discussed. Glacial outwash and water influx is also mentioned. The uranium deposits in a number of States in the USA are covered. The Witwatersrand placers are discussed in several papers. Refs, figs, tabs.

17741 **(PB—88-855788/XAB) Uranium mining and milling environmental studies. January 1970-December 1987 (citations from the Engineering Index data base). Report for January 1970-December 1987.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 120p. NTIS PC N01/MF N01.

Supersedes PB—84-869213.

This bibliography contains citations concerning environmental and social aspects of uranium mining, milling, and ore treatment. Environmental and social aspects include air and water pollution, public health, occupational safety, land reclamation, and waste disposal. The citations refer to monitoring and control of contaminants, and environmental surveys and impact statements for specific areas in the vicinity of mining and ore treatment facilities. There are also references to health studies performed on miners and millworkers. (This updated bibliography contains 325 citations, 84 of which are new entries to the previous edition.)

0504 Feed Processing

17742 **(INIS-BR—936) Effect of some ions in the flotation of phosphorus uraniferous ore from Itatain.** Claus, O.L. (Minas Gerais Univ., Belo Horizonte (Brazil)). 1985. 48p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701473/JAW.

The influence of several ions in the flotation of phosphorus - uraniferous ore from Itataia were evaluated. Testing with distillated water, water from Itataia region and water prepared in laboratory by nitrate ion addition were done. (E.G.).

0505 Uranium Enrichment

REFER ALSO TO CITATION(S) 17773

17743 **(K/ETAC—46) An analytical study of corrosion effects on the structural integrity of a peripheral cooler section: Part 1.** McGrath, S.V.; Kirkland, W.K. (Oak Ridge Gaseous Diffusion Plant, TN (USA). Enrichment Technology Applications Center). Jan 1988. Contract AC05-84OT21400. 159p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88005909/JAW.

This report presents the results of a finite element stress analysis investigating the effects of corrosion on the mechanical strength of a peripheral cooler section. The analysis assumes that corrosion results in a uniformly increased interior channel of the cooler. The as-built cooler section and three sections with increasingly larger channels are analyzed by the ADINA finite element code. Stresses for each cooler section at an operating pressure of 120 psi and an overpressure of 300 psi are presented. Additionally, the as-built cooler section is analyzed to an extreme overpressure of 1500 psi. The analysis indicates that the peripheral cooler can maintain structural integrity at severely reduced web thicknesses and significant overpressures. Part 2 of this report contains plots of the cooler sections at pressure and steady-state operating temperatures. 112 figs.

17744 **(K/OA—6008) International Atomic Energy Agency UF_6 cascade header pipe test loop: Instruction manual.** Fields, L.W. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Nov 1987. Contract AC05-84OT21400. 52p. (ISPO—268). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005600/JAW.

The UF_6 cascade header pipe test loop designed for IAEA will simulate operating flows, pressures, and uranium deposition typical of gas centrifuge enrichment plant header piping. Its purpose is twofold: (1) to enable the IAEA Inspectorate to evaluate and to calibrate portable instrumentation designed to verify the enrichment of UF_6 gas under static and dynamic operating conditions in plant piping; and (2) to train inspectors in the acquisition and interpretation of gamma ray and X-ray fluorescence spectral data using such instrumentation.

17745 **Atomic vapor laser isotope separation using resonance ionization.** Comaskey, B.J.; Crane, J.K.; Erbert, G.V.; Haynam, C.A.; Johnson, M.A.; Morris, J.R.; Paisner, J.A.; Solarz, R.W.; Worden, E.F. (Lawrence Livermore National Lab., CA, USA). pp 245-249 of Resonance ionization spectroscopy 1986. Proceedings of the third international symposium on resonance ionization spectroscopy and its applications held at the University College of Swansea, Wales, on 7-12 September 1986. Hurst, G.S.; Morgan, C.G. (eds.). Bristol, England; Institute of Physics (1986). (CONF-8609132—).

From Resonance ionization spectroscopy and its application; Swansea, UK (7 Sep 1986).

Price Pound 35.00.

In June 1985, the Department of Energy announced the selection of atomic vapor laser isotope separation [AVLIS] as the technology to meet the United States' future need for enriched uranium. Resonance photoionization is the heart of the AVLIS process. The authors discuss those fundamental atomic parameters that are necessary for describing isotope-selective resonant multistep photoionization along with the measurement techniques employed. The methodology adopted is illustrated with examples of other elements that are under study in the program.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 17846, 18657, 18738, 19859

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 17779, 17789, 18616, 18747, 18758

17746 **(CONF-871038—3) Uranium and zirconium mass transfer testing of 5.5-cm-diam centrifugal contactors: Consolidated Fuel Reprocessing Program.** DeMuth, S.F. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002679/JAW.

From 5. symposium on separation science and technology for energy application; Knoxville, TN, USA (26 Oct 1987).

This report consists of the viewgraphs used during the oral presentation entitled "Uranium and Zirconium Mass Transfer Testing of 5.5-cm-diam Centrifugal Contactors". 11 figs., 8 tabs.

17747 **(CONF-871038—9) Behavior of americium in the strip stages of the TRUEX process.** Chiarizia, R.; Horwitz, E.P.; Gatrone, R.C. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005957/JAW.

From 5. symposium on separation science and technology for energy application; Knoxville, TN, USA (26 Oct 1987).

The TRUEX (transuranium extraction process), recently developed at Argonne National Laboratory, separates and concentrates transuranium elements from acidic nuclear wastes. It is based on the use of the neutral extractant octyl(phenyl)-N,N-diisobutylcarbamoylmethylphosphine oxide (CMPO). This is combine with tributylphosphate (TBP) and a diluent to formulate the TRUEX process solvent. An attractive feature of the TRUEX process is that it allows the separation of americium from plutonium by using two different strip solutions. A detailed knowledge of the chemistry of americium in the stripping stages is essential for a successful Am/Pu separation. In this work the distribution ratio of Am(III) between TRUEX process solvent and diluted nitric acid has been measured in up to six successive strip experiments. The behavior of americium has been correlated to specific characteristics of the organic and aqueous phase, such as purity of the extractant and composition of the aqueous phase. The conclusion has been reached that with simulated waste solutions and with CMPO having a sufficient purity, it is possible to remove more than 99.99% of americium from the loaded organic phase. 13 refs., 3 figs., 2 tabs.

17748 **(CONF-871045—6) Status of the joint United States/Japanese criticality data development program for the Fast Breeder fuel cycle.** Takeda, H.; Kishimoto, Y.; Matsumoto, T.; Haire, M.J. (Oak Ridge National Lab., TN (USA); Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)). 1987. Contract AC05-84OR21400. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87012932/JAW.

From International seminar on nuclear criticality safety; Tokyo, Japan (19 Oct 1987).

An experimental program is described to accumulate the basic criticality data on uranium-plutonium aqueous solution systems, including pin and water systems. This experimental program, managed by the Consolidated Fuel Reprocessing Program, utilized existing critical experiment facilities. However, Japan at least for the near future, does not have a facility for conducting critical experiments where fissible solution can be treated and processed. Therefore, Japan has remoted the existing US experimental program as well as enlarged the program so that a close cooperative relationship may exist in this area. This paper is an update of a description of the program presented in September 1985. 9 refs., 5 figs., 1 tab.

17749 **(CONF-871101—2) Secondary solvent cleanup using activated alumina: Laboratory development.** Mailen, J.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE87010603/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

The primary cleanup of PUREX solvent removes short-chain acidic organic degradation products effectively but leaves a variety of degradation products. These materials cause problems with phase separation and retention of cations. A process using activated alumina to remove secondary degradation products received laboratory development at Oak Ridge National Laboratory using Savannah River Plant and Idaho Chemical Processing plant solvents, was further developed at Savannah River Laboratory using SRP solvent, and was tested at full scale at SRP. This paper describes the development at ORNL. 6 refs., 1 fig., 1 tab.

17750 **(DOE/EA—0306) Environmental assessment: Fuel processing restoration at the Idaho National Engineering Laboratory.** (EG and G Idaho, Inc., Idaho Falls (USA)). Aug 1987. Contract AC07-76ID01570. 311p. NTIS, PC A16/MF A01; 1; GPO Dep. Order Number DE88005005/JAW.

The purpose of this Environmental Assessment (EA) is to provide sufficient evidence to assist DOE decision makers in determining whether to prepare an environmental impact statement or a finding of no significant impact for the proposed construction, operation, and decommissioning of the Fuel Processing Restoration (FPR) project at the Idaho National Engineering Laboratory (INEL). The FPR project includes (a) a replacement facility, to be called the Fuels Processing Facility (FPF), which would safely, efficiently, and effectively process recoverable irradiated naval and research reactor fuels to recover uranium for recycle and reuse in defense programs; and (b) a new liquid low-level waste (LLW) treatment and disposal system to improve waste management practices at the Idaho Chemical Processing Plant (ICPP). The EA examines and compares the environmental impacts of the proposed FPR project and reasonable alternatives at the ICPP. This Environmental Assessment (EA) has been prepared in accordance with the requirements of the National Environmental Policy Act of 1969, as amended (NEPA), and the requirements of the CEQ Regulations. 214 refs., 32 figs., 57 tabs.

17751 **(FEI—1740) Calculating the critical parameters of multiplying homogeneous systems containing gadolinium.** Gurin, V.N.; Poplavko, A.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 13p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701423/JAW.

Three-group constants for gadolinium are suggested. The expression for a factor of gadolinium capture cross section blocking in thermal group is found. Experimental calculational foundation of gadolinium constants is carried out by analysing the effective neutron multiplication factor (K/sub eff/) for 25 assemblies with gadolinium, uranium and plutonium solutions. The mean error of K/sub eff/ calculations using the suggested constants for gadolinium is not higher than +-1%, the maximum error is +-2%. The calculations are carried out by the MMK-22 program implemented the Monte Carlo method. 5 refs.; 6 figs.

17752 **(INCT—2020/2/C/B) Study of reductive reextraction of plutonium in the Purex process.** Poczynajlo, A. (Institute of Nuclear Chemistry and Technology, Warsaw (Poland)). 1985. 135p. (In Polish). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701312/JAW.

Received in Dec 1987.

The methods of separation of U and Pu in the Purex process and the thermodynamic and kinetic properties of Pu(4) reductants are discussed. The kinetic equation of the process of reductive reextraction of plutonium for the first order reaction with respect to Pu(4) is derived. The kinetics of plutonium reextraction with the use of uranium (4), ascorbic acid and other reductants has been studied. The necessity of application of the stoichiometric excess of reductant has been explained by simultaneously occured reoxidation process of plutonium. The method of calculation of the steady-state plutonium concentration profiles has been elaborated for counter-current separation of U and Pu in multistage contactor. 90 refs., 20 tabs., 29 figs.

17753 **(KFK—4177) Lectures of the 6th status report on the project for reprocessing and waste treatment on March 13th/14th 1986.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Wiederaufarbeitung und Abfallbehandlung). Apr 1987. 545p. (In German). (PWA—89/86; CONF-8603235—). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW.

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

The report contains 28 lectures on reprocessing mainly LWR and also FBR fuel and on the treatment of waste concentrates from the PUREX process. They were recorded separately for the databases INIS and ENERGY. The lectures reflect the state of development with reference to the large 350 t/year reprocessing plant at Wackersdorf in West Germany, for which the first part authorisation for erection was granted by the appropriate authorities.

17754 (KFK—4177, pp 14-38) **Technically tested development of KfK for use at Wackersdorf reprocessing plant.** Kroebel, R. Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

Targets of the project 'Reprocessing and waste treatment' at KfK are explained by diagrams with regard to the Wackersdorf reprocessing plant, and the development at the head end to a degree of 'active on half technical scale', 'technically inactive' and 'technically active', of waste treatment for extraction for remote handling technique and for process control are explained.

17755 (KFK—4177, pp 39-51) **Report on reprocessing plant at Wackersdorf.** Mueller von Blumencron, H. (Deutsche Gesellschaft fuer Wiederaufarbeitung von Kernbrennstoffen m.b.H., DWK, Hannover, Germany, F.R.). Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

The present state of planning and the authorisation process for building the German reprocessing plant in Wackersdorf are described. The development and test work accompanying the planning done by the German Society for Reprocessing Nuclear Fuels

(DWK) which are used for optimisation in various functional areas, the increase of the safety and availability, are explained. A survey is given of the programme of work 1983-1988 of the hot demonstration plant at the Wackersdorf reprocessing plant, which is aimed at securing the flow diagrams and preparation of the plant for operation. Finally, there is a report on the state of hot operation of the PAMELA plant at Mol (Pilot plant Mol for manufacturing waste suitable for final storage).

17756 (KFK—4177, pp 52-67) **Process technology prospects of reprocessing.** Ebert, K. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Heisse Chemie). Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

The reprocessing of fast breeder reactor fuel makes great demands on further development and adaptation of the PUREX process in the chemical and process technology fields. In order to improve the cost structure, the space/time yields and the availability of process plants, examples are given of further development of existing process stages (reactor fuel dissolution, 1st extraction cycle, U/Pu purification, treatment of waste gas) and examples of the development of new process steps (electrical dissolving, electro-chemical centrifugal extractor for re-extraction of plutonium, crystallisation for uranium and plutonium purification). Other points for optimisation are measurement and control techniques and the choice of the right materials. Finally, there is reference to the effective exchange of knowhow in the research and development area and the necessity for international collaboration.

17757 (KFK—4177, pp 81-97) **Reprocessing development and work relevant to waste treatment and test rigs at IRCH.** Ache, H.J. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Radiochemie). Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

There are reports on the work of the Institute of Radiochemistry (IRCH) at the Karlsruhe Nuclear Research Centre in connection with reprocessing and waste treatment. The fixing of krypton by irreversible absorption in zeolite and the enrichment of tritium by the CE/CE process are to the fore in the field of technical radio-chemistry (combined electrolysis/catalytic exchange). In the analytical sector, i.e. process analysis and other analyses, the main points are the development and testing of in-line instruments for process control and as monitoring instruments in reprocessing plants and working out analytical methods for determining uranium, plutonium, fission products, radiolysis products and corrosion products and surface analysis. Hot analytical test rigs are built up for testing process analysis procedures in realistic conditions. The use of laser spectrum photometry, time resolved laser fluorescence spectrometry, laser Raman spectroscopy, photo-acoustic spectroscopy, K-edge absorptiometry, X-ray fluorescence spectroscopy and neutron measuring processes is explained. Finally, some possibilities of simplification and the improved economy of the reprocessing process are dealt with, for example extraction chromatographic process control, voloxidation, decontamination of acid and basic waste flows.

17758 (KFK—4177, pp 98-113) **Electrolysis processes in reprocessing: From laboratory test to technical use in Wackerdorf reprocessing plant.** Weishaupt; Hausberger; Schmieder. (Wiederaufbereitungsanlage Karlsruhe Betriebsgesellschaft m.b.H., WAK, Eggenstein-Leopoldshafen, Germany, F.R.; Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Heisse Chemie). Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

The use of electrolysis apparatus in the extraction process of the Wackersdorf reprocessing plant can be regarded as a complete success due to the practically fault-free behaviour in the 2nd plutonium cycle (ZB-EMMA as 12 stage mixing sedimenter with oxidation cell ROXI) and the improved, more stable, behaviour in the 1st uranium/plutonium separation battery. Faults inside the process components can be recognised more quickly from the voltage data of the individual electrolysis cells, their course can be followed precisely and immediate counteraction can be taken. Functioning can be maintained, even in extreme operating and flow diagram conditions, no poisoning or inhibition occurred at the working electrodes and the entry of corrosion products from the electrode materials is practically at the detection limit and is lower than the content of these materials in the fuel.

17759 (KFK—4177, pp 115-134) **Previous results from experimental operation of the plutonium test plant (PUTE).** Galla, U.; Schmieder, H. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Heisse Chemie). Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

The test plant for the demonstration of the 1st uranium/plutonium separation cycle and the second cycle for plutonium purification, consisting of three pulsed screen floor columns and 2 electro-reoxidation cells was tested in 3 large campaigns with a throughput of a total of 270 kg of plutonium. There are reports on these campaigns and the working parameters examined in them. The electrolytic plutonium re-extraction in the Pu purification cycles was demonstrated with the best result and the complex processes in the pulsed column are understood. Regarding the U/Pu separation cycle, the ELKE column supplies sufficient separation factors, but the interpretation is not satisfactory yet and requires further experiments in representative conditions, for which the plant is being modified and expanded.

17760 (KFK—4177, pp 209-231) **Results from operating the fuel bundle cutting tool.** Kunze, P.; Kirsch, W. (Wiederaufbereitungsanlage Karlsruhe Betriebsgesellschaft m.b.H., WAK, Eggenstein-Leopoldshafen, Germany, F.R.). Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

In the German Wackersdorf reprocessing plant (WAW), a fuel bundle cutting tool is provided for the mechanical reduction of the fuel elements in size. A newly developed prototype tool was tested at the Technical Centre for Component Testing (TEKO) of the Karlsruhe Nuclear Research Centre from spring 1983 to the end of 1984. There are reports on the main points of the research program: Selection of blades for the fuel bundle cutting tool, conversion for BWR's and PWR's, cutting forces, wear of the blade and guide bars, opening crossection and size of the cut material, occurrence of shavings and dust, cuts in the plenum area. Operating and handling modifications resulted from experience in use, whose success is to be demonstrated in 1987.

17761 (KFK—4177, pp 232-256) **Measurements of aerosol development when mixing and transporting solutions in reprocessing plants.** Furrer, J.; Krissel, R.; Leibrecht, H.; Linek, A.; Herrmann, F.J.; Nemes, B.; Stojanik, B. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Lab. fuer Aerosolphysik und Filtertechnik, LAF; Wiederaufbereitungsanlage Karlsruhe Betriebsgesellschaft m.b.H., WAK, Eggenstein-Leopoldshafen, Germany, F.R.). Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

Aerosol measurements were taken at the place of origin in an inactive experimental plant with the aim or providing data for reliable pre-calculation for planning and construction of a reprocessing plant and for authorising authorities and experts. Further, aerosol measurements were taken in the containment waste gas system of the highly radioactive waste store of the Wackersdorf reprocessing plant. The strengths of aerosol sources when stirring and transporting with air and with steam (stirring in air, air ventilation, steam jet) depend on the number and size of the gas bubbles developed in operation and on the transport waste air (humidity content). The values determined from the BEATE containment waste gas test rig showed good agreement with those measured at Wackersdorf.

17762 (KFK—4177, pp 293-305) **Thermal fission gas release from burnt-up LWR mixed oxide fuels.** Ali, S.A.; Berndt, U.; Moedritscher, W. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Radiochemie). Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

The release of the fission gases tritium, iodine and krypton from mixed oxide fuels in successive oxidation and reduction stages was examined in the temperature range of 350-800/sup 0/C using O/sub 2/ as the oxidation medium and H/sub 2/ or CO as the reduction medium. It was found that to release 99.9% tritium, a single oxidation stage is necessary, but for the complete evaporation of krypton and iodine, about 10 to 13 process stages are necessary. Solution experiments on the thermally oxidatively or reductively treated material showed a significantly improved solubility.

17763 (KFK—4177, pp 306-312) **Aims of modernisation of MILLI.** Goldacker, H.; Bleyl, H.J.; Schmieder, H. Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

The modernisation of the laboratory extraction plant MILLI is directed towards greater flexibility of the whole process installation for the more precise balance of volumes and materials and for better evaluation. The planned improvements concern: The clearing of the extractor feed solution, the access to and replacement of mixing sedimenters, the intermediate treatment of aquaeous scrubbing solutions and the recycling of organic solutions, the separation of troublesome phases from the refined and product flows, the improvement of the accuracy of dosing and volume balancing, a fast and complete evaluation of process data and finally, flexibility with regard to the in-line instrumentation and the introduction of developed extractors.

17764 (KFK—4177, pp 313-326) **Tritium scrubbing in pulse columns.** Eggert, E.; Feucht, P.; Lessle, E.M.; Schmidt, H. Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

A pulsed floor column for washing with dilute nitric acid was tested for removing the tritium from the organic product flow of the PUREX process, into which it has penetrated due to the carried over aquaeous phase. Phases loaded with uranium were used for the test, and the tritium was simulated by deuterium. The required decontamination factor of 40 is far exceeded with a column length of 6 m at a column diameter of 210.5 mm, where the flow ratio can be increased from the initially required 20 to 40. This means halving the tritiated quantity of wash water.

17765 (KFK—4177, pp 326-342) **Radio tracer technique diagnosis of two-phase flow in industrial extraction apparatus.** Merz, A. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Lab. fuer Isotopentechnik). Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

Radio tracer technique methods were developed in the Laboratory for Isotope Technique for flow mechanics examination in apparatus of liquid/liquid extraction, which are matched to specific PUREX material systems, but are generally applicable. The marker techniques were tested in connection with the examination of special fluid dynamics problems of axial and radial mixing and the dwell time behaviour in the separation layer of the coalescing phase. The experimental plant was a pulsating test column with variable floor geometry. The method developed was transferred to extraction apparatus on the industrial scale of the uranium extraction cycle. The possibilities of the diagnosis of fluid dynamics conditions and their effect on extraction was shown by the example of a screen floor column. Dwell time behaviour of the product flow, internal circulation of the washing phase and phase distribution in the mixing and sedimentation chamber were the aims in a five stage mixer/settler with a high external phase ratio.

17766 (KFK—4177, pp 343-362) **Behaviour of technetium and ammonium in the Wackersdorf reprocessing plant.** Boukis, N.; Ertel, D.; Kanellakopulos, B.; Schaarschmidt, U.; Stollenwerk, A.H.; Weishaupt, M. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Heisse Chemie; Wiederaufbereitungsanlage Karlsruhe Betriebsgesellschaft m.b.H., WAK, Eggenstein-Leopoldshafen, Germany, F.R.). Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

The behaviour of technetium in the 1st cycle of the PUREX process was examined with simulated solutions in a laboratory experiment and during the Wackersdorf reprocessing plant campaigns with fuel from the MZFR or KWO reactor. In the 1st extractions, more than half of the technetium fed in with the fuel solution is transported directly to the high activity waste. The rest follows the plutonium in the uranium/plutonium separation stage and is separated from this in plutonium purification. The refined material of the cleaning cycles is concentrated in WAK and is recycled to the highly radioactive feed solution. Taking into account a certain accumulation in the 1st extraction, the technetium latterly dissolved from the fuel lands completely in the high activity waste. In the planned large 350 t/year reprocessing plant at Wackersdorf (WA-350) pre-purification of the recycled refined material is provided, which avoids this accumulation. Technetium has been proved to contribute to hydrazine consumption in the uranium/plutonium separation battery. A by-product of this hydrozine oxidation by nitric acid with technetium as catalyst is ammonia. The ammonia formed is sent via the path of refined material recycling to the high activity waste at WAK. Ammonium is decomposed by nitrogen oxide fed in or by radiolytically produced nitrite. Only 0.4 m mol/litre was found in the high activity waste concentrate.

17767 (KFK—4177, pp 449-463) **Methods of determining the inventory of a running reprocessing plant.** Alberti, A.; Lausch, J.; Weh, R. Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

The roughly 300 individual process variables (status information, analogue values, alarms and calculated values) are handed over to the independent graphic system for information processing and are stored on discs and tapes. The results are available here for further investigations on balances of fission material. (oriog./RB).

17768 (KFK—4177, pp 493-530) **Testing of in-line instruments developed by IHCH.** Roemer, J.; Groll, P.; Persohn, M.; Roeder, L.; Schlosser, B. Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

In the reprocessing of burnt-up fuel elements, quick and clear indication of the concentration of process materials is necessary at various places, in order to be able to control the plant effectively. Various in-line instruments were developed at IHCH for this purpose.

17769 (KFK—4177, pp 505-530) **Neutron monitors for monitoring process and waste flow in a reprocessing plant.** Wagner, K.; Wuerz, H.; Becker, H.J. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Hauptabteilung Ingenieurtechnik; Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Neutronenphysik und Reaktortechnik; Wiederaufbereitungsanlage Karlsruhe Betriebsgesellschaft m.b.H., WAK, Eggenstein-Leopoldshafen, Germany, F.R.). Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

The detection of neutrons offers the possibility of determining the plutonium and monitoring the criticality directly at the part of the plant concerned. The state of neutron monitor development and the basic possibilities of application for process and safety monitoring are shown. Requirements for the equipment and necessary quality assurance measures are discussed with examples. Examples are explained for passive neutron measurement (Pu cleaning cycles, Pu loading of refined material flow) and for the active measurement of neutrons using a steady neutron source (Pu and Cm/Pu on fuel element cans, criticality for vibration of rods, fuel element monitors etc.).

17770 (KFK—4177, pp 531-539) **Neutron profile measurements on pulse columns.** Becker, H.J.; Wuerz, H. (Wiederaufbereitungsanlage Karlsruhe Betriebsgesellschaft m.b.H., WAK, Eggenstein-Leopoldshafen, Germany, F.R.; Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Neutronenphysik und Reaktortechnik). Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

The use of neutron monitors to check the operating behaviour of PUREX process plant was examined on extraction columns of the PUTE plutonium test plant. There is a report on the installation of the counter tube and the behaviour of the monitors during operation of the column (counter tube, measurig electronics, processing the measured values). The Pu concentration along a column can be roughly estimated by the operator from the measured counting rates. The Pu profile is correctly shown. Experience gained from faults on the measuring electronics and in collecting measurements led to improvements which have been implemented in neutron measurements on various process equipments of the Wackersdorf reprocessing plant. The operators of the plant therefore have an important additional source of on-line process information available to them.

17771 **Calculational assessment of critical experiments with mixed-oxide fuel pin arrays moderated by organic solution.** Smolen, G.R.; Funabashi, H. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **54**: 197-198(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

Critical experiments have been conducted with organically moderated mixed-oxide (MOX) fuel pin assemblies at the Pacific Northwest Lab. Critical Mass Lab. These experiments are part of a joint exchange program between the US Dept. of Energy and the Power Reactor and Nuclear Fuel Development Corp. of Japan in the area of criticality data development. The purpose of these experiments is to benchmark computer codes and cross-section libraries and to assess the reactivity difference between systems moderated by water and those moderated by an organic solution. Past studies have indicated that some organic mixtures may be better moderators than water. This topic is of particular importance to the criticality safety of fuel processing plants where fissile material is dissolved in organic solutions during the solvent extraction process. In the past, it has been assumed that the codes and libraries benchmarked with water-moderated experiments were adequate when performing design and licensing studies of organically moderated systems. Calculations presented in this paper indicated that the Scale code system and the 27-energy-group cross-section library accurately compute k/sub eff/ for organically moderated MOX fuel pin assemblies. Furthermore, the reactivity of an organic solution with a 32 vol % TBP/68 vol% NPH mixture in a heterogeneous configuration is the same, for practical purposes, as water.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 17862, 18203, 18360

17772 **(EGG-M—15087) Transporting TMI-2 core debris to INEL: Public safety and public response.** Schmitt, R.C.; Reno, H.W.; Young, W.R.; Hamric, J.P. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 7p. (CONF-871102—2). NTIS, PC A02. Order Number DE88005805/JAW.

From International waste management conference; Kowloon, China (29 Nov 1987).

This paper describes the approach taken by the US Department of Energy to ensure that public safety is maintained during transport of core debris from the Unit-2 reactor at the Three Mile Island Nuclear Power Station near Harrisburg, PA, to the Idaho National Engineering Laboratory near Idaho Falls, ID. It provides up-to-date information about public response to the transport action and discusses DOE's position on several institutional issues. The authors advise that planners of future transport operations be prepared for a multitude of comments from all levels of federal, state, and local governments, special interest groups, and private citizens. They also advise planners to keep meticulous records concerning all informational transactions. 3 figs.

17773 **(K/SS—471) Proposal for modifications to US Department of Transportation specification 21PF-1 fire and shock resistant phenolic foam-insulated metal overpack.** Barlow, C.R.; Ziehlke, K.T.; Pryor, W.A.; Frazier, J.L.; Kellogg, D.R.; Stout, F.W. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Jan 1988. Contract AC05-84OT21400. 119p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005786/JAW.

Slightly enriched product uranium hexafluoride (UF_6) shipped from enriching plants for the world's nuclear power plants must be protected in order to conform to domestic and international transport regulations. The principal overpack currently in use is the US Department of Transportation (DOT) Specification 21PF-1 which protects Model 30 UF_6 cylinders (Title 49, Code of Federal Regulations, Part 178.121, Specification 21PF-1; Fire and Shock Resistant, Phenolic-Foam Insulated, Metal Overpack). Operational problems developed from both design and lack of maintenance have resulted in the entry of water into the insulation. To minimize this water entry, design modifications are necessary. Proposed modifications for existing overpacks are to be made only after any water absorbed within the insulation is reduced to an acceptable level. New 21PF-1 overpacks will be fabricated under an enhanced design. In both cases, proposed quality assurance/control requirements in the fabrication, modification, use and maintenance of the overpacks are applicable to fabricators, modifiers, owners and users. The phenolic foam is the thermal barrier, which maintains the UF_6 below its triple point in the event of exposure to elevated temperatures. Evaluation of the thermal qualities of the overpack required extensive analytical modeling correlated with experimental measurement. An experimental program was devised to measure

the thermal conductivity and heat capacity of the phenolic foam from room temperature to approximately 1475°F (1073°K).

17774 **(NUREG—1140-Final) A regulatory analysis on emergency preparedness for fuel cycle and other radioactive material licensees: Final report.** McGuire, S.A. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Accident Analysis). Jan 1988. 123p. NTIS, PC A06/MF A01 - GPO. Order Number TI88900311/JAW.

The question this Regulatory Analysis sought to answer is: should the NRC impose additional emergency preparedness requirements on certain fuel cycle and other radioactive material licensees for dealing with accidents that might have offsite releases of radioactive material. To answer the question, we analyzed potential accidents for 15 types of fuel cycle and other radioactive material licensees. An appropriate plan would: (1) identify accidents for which protective actions should be taken by people offsite; (2) list the licensee's responsibilities for each type of accident, including notification of local authorities (fire and police generally); and (3) give sample messages for local authorities including protective action recommendations. This approach more closely follows the approach used for research reactors than for power reactors. The low potential offsite doses (acute fatalities and injuries not possible except possibly for UF_6 releases), the small areas where actions would be warranted, the small number of people involved, and the fact that the local police and fire departments would be doing essentially the same things they normally do, are all factors that tend to make a simple plan adequate. This report discusses the potentially hazardous accidents, and the likely effects of these accidents in terms of personnel danger.

17775 **(ORNL/Sub—87-00421/1) Cask fleet operations study.** (Nuclear Assurance Corp., Norcross, GA (USA)). Jan 1988. Contract AC05-84OR21400. 274p. NTIS, PC A12. Order Number DE88006159/JAW.

The Nuclear Waste Policy Act of 1982 assigned to the Department of Energy's (DOE) Office of Civilian Waste Management the responsibility for disposing of high-level waste and spent fuel. A significant part of that responsibility involves transporting nuclear waste materials within the federal waste management system; that is, from the waste generator to the repository. The lead responsibility for transportation operations has been assigned to Oak Ridge Operations, with Oak Ridge National Laboratory (ORNL) providing technical support through the Transportation Operations Support Task Group. One of the ORNL support activities involves assessing what facilities, equipment and services are required to assure that an acceptable, cost-effective and safe transportation operations system can be designed, operated and maintained. This study reviews, surveys and assesses the experience of Nuclear Assurance Corporation (NAC) in operating a fleet of spent-fuel shipping casks to aid in developing the spent-fuel transportation system.

0510 Marketing, Economics, And By-products

17776 **(DOE/EIA—0477(86)) Domestic uranium mining and milling industry: 1986 viability assessment.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). 23 Nov 1987. 112p. NTIS, PC A06/MF A01 - GPO; 1; GPO Dep. Order Number DE88002928/JAW.

This report presents the fourth annual assessment of the domestic uranium mining and milling industry's resource capability, supply response capability, financial capability, and import commitment dependency. The data and analysis in support of this assessment and the report itself have been developed pursuant to Public Law 97-415, the Nuclear Regulatory Commission (NRC) Authorization Act of 1982. The report provides information on recent uranium supply, demand, and marketing conditions, as well as projections of the domestic uranium industry's ability to continue to supply the needs of the domestic nuclear power industry through the year 2000. Industry capability is assessed under a variety of assumed conditions with respect to hypothetical disruptions of uranium imports. 13 refs., 26 figs., 37 tabs.

17777 **Strategic outlook for the US Dept. of Energy uranium enrichment enterprise.** Longenecker, J.R. *Transactions of the American Nuclear Society;* 54: 69-70(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

Mounting problems in the early 1980s resulted in a business crisis for the US uranium enrichment enterprise. To address these problems, the US Dept. of Energy (DOE) developed and announced in 1984 a plan for reestablishing its competitive position in the world marketplace. This recovery plan has been very successful. The US DOE is now implementing the third phase of that strategy, institutional restructuring. Maintaining a healthy, stable, and competitive uranium enrichment capability in the US is a high-priority effort for DOE, whose uranium enrichment enterprise has two major goals: in the near term, DOE's goal is to provide reliable, competitive enrichment services to commercial and defense customers in a manner that assures a reasonable return on the government's investment. In the future, to assure adequate supplies of competitively priced nuclear fuel, DOE must adapt to the changing needs of the marketplace. Thus, we must stabilize and maintain the long-term vitality of the US enrichment enterprise by restructuring it and by providing the means by which the private sector can become involved in the business. Restructuring and private ownership obviously will require the approval of Congress. To achieve these goals, DOE has developed strategic objectives, which are briefly described.

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REFER ALSO TO CITATION(S) 17753, 17755, 17757, 17758, 17761, 17843, 17845, 18244, 18245, 18746, 18795, 18820, 18984, 19607, 19627, 19684, 19691, 19692, 19693, 19694, 19695, 19696, 19697, 19698, 19699, 19700, 20546

17778 **(INIS-GB—121) Facts on Nirex. The disposal of radioactive waste.** (Nuclear Industry Radioactive Waste Executive, Harwell (UK)). 1987. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88752361/JAW.

This folder contains twelve two-page leaflets (fact sheets) which answer questions posed about UK NIREX Ltd, its operations and radioactive waste. NIREX (the Nuclear Industry Radioactive Waste Executive) is the organisation responsible for implementing the British Government's policy for the disposal of most low- and intermediate-level radioactive waste produced in the United Kingdom. The questions posed are; what is NIREX. What is radioactivity. What is radioactive waste. Radioactive waste, what are the options. What is a radioactive waste repository. Some aspects of such a repository are then explained - how engineered barriers work, how geological barriers work, how long can concrete last, how is the radioactive waste transported, how are repository sites identified. The last two leaflets consider why do we need research, and look at radioactive waste management worldwide. The answers are in non-technical language and are short.

17779 **(ORNL/TM—10105) Radiological characteristics of light-water reactor spent fuel: A literature survey of experimental data.** Roddy, J.W.; Mailen, J.C. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006049/JAW.

This survey brings together the experimentally determined light-water reactor spent fuel data comprising radionuclide composition, decay heat, and photon and neutron generation rates as identified in a literature survey. Many citations compare these data with values calculated using a radionuclide generation and depletion computer code, ORIGEN, and these comparisons have been included. ORIGEN is a widely recognized method for estimating the actinide, fission product, and activation product contents of irradiated reactor fuel, as well as the resulting heat generation and radiation levels. These estimates are used as source terms in safety evaluations of operating reactors, for evaluation of fuel behavior and regulation of the at-reactor storage, for transportation studies, and for evaluation of the ultimate geologic storage of spent fuel. 82 refs., 4 figs., 17 tabs.

17780 **(AERE-R—12389) Washing of combustible plutonium contaminated material.** Ashby, P.J.; Greenfield, B.F.; Wilkins, J.D. (UKAEA Harwell Lab. Chemistry Div.). Aug 1987. 20p. (PCMRP—86-P13). H.M. Stationery Office, London, price Pound 4.00.

The results of several years development of the washing process for the decontamination of combustible plutonium contaminated material are reported. A substantial (85-90%) decontamination can be achieved using a 1M sodium hydroxide wash solution. Outline flowsheets for the main washing process and treatment of a number of the secondary waste streams are presented.

17781 **(AERE-R—12547) Programme of research into radioactive waste management and disposal. Testing and evaluation of conditioned waste and engineered barriers. Annual report 1986.** Ewart, F.T.; Smith, A.J.; Walters, W.S.; Williams, S.J. (UKAEA Harwell Lab. Chemistry Div.; Department of the Environment, London (UK)). Sep 1987. 7p. H.M. Stationery Office, London, price Pound 4.00.

Progress made under the Radiolytic Oxidation contract to the end of 1986 is reviewed. Previous work in this laboratory on the solubility of neptunium under possible waste disposal conditions and in the presence of gamma irradiation is discussed. It has been found that gamma irradiations of neptunium(IV) hydroxide in water that has been equilibrated with either bentonite or granite leads to enhanced solubilities consistent with oxidation from the (IV) state. Irradiation in concrete equilibrated water gives no increase in the solubility which remains below the detection limit and suggests that radiolytic oxidation does not occur in this high pH water. The addition of iron filings reduces the measured neptunium concentrations in the bentonite and granite waters. Initial work in other areas of the contract is briefly outlined.

17782 **(CONF-871101—9) The application of advanced remote systems technology to future waste handling facilities: Waste Systems Data and Development Program.** Kring, C.T.; Herndon, J.N.; Meacham, S.A. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87014779/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

The Consolidated Fuel Reprocessing Program (CFRP) at the Oak Ridge National Laboratory (ORNL) has been advancing the technology in remote handling and remote maintenance of in-cell systems planned for future US nuclear fuel reprocessing plants. Much of the experience and technology developed over the past decade in this endeavor are directly applicable to the in-cell systems being considered for the facilities of the Federal Waste Management System (FWMS). The ORNL developments are based on the application of teleoperated force-reflecting servomanipulators controlled by an operator completely removed from the hazardous environment. These developments address the nonrepetitive nature of remote maintenance in the unstructured environments encountered in a waste handling facility. Employing technological advancements in dexterous manipulators, as well as basic design guidelines that have been developed for remotely maintained equipment and processes, can increase operation and maintenance system capabilities, thereby allowing the attainment of two FWMS major objectives: decreasing plant personnel radiation exposure and increasing plant availability by decreasing the mean-time-to-repair in-cell maintenance and process equipment. 5 refs., 7 figs.

17783 **(DPSTSAD—200-5) Safety assessment: 200 Area, Savannah River Plant: F/H Effluent Treatment Facility.** Aabye, D.C.; Hurrell, S.J.; Jenkins, C.E.; Mason, C.L.; Walker, D.H. (Science Applications International Corp., Oak Ridge, TN (USA)). Dec 1986. Contract AC09-76SR00001. 66p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004275/JAW.

The F/H Effluent Treatment Facility (F/H ETF) will be located in H-Area of the Savannah River Plant, and is designed to decontaminate routine process effluents and accidental radioactive releases from the 200 (F- and H-) Areas. The new facility will consist of impermeable storage basins in both areas, a process building, and the associated tankage, equipment, and piping. The purpose of this document is to provide a general hazards analysis that estimates consequences and risk from postulated accidents, including those initiated by natural events. A general description of the F/H ETF is provided in Section 2.0. An evaluation of the radiological consequences and risks from a spectrum of potential accidents associated with operation of the F/H ETF is presented in Section 3.0. Information for the processing facility is provided in Section 3.2 and Appendices A and B. Risks from operation of the new storage basins are estimated based on the Seepage and Retention Basins Safety Analysis Report. 32 refs., 4 figs., 25 tabs.

17784 **(Juel—2153) Physical, chemical and mechanical analyses at cemented radioactive waste products.** Assmann, D. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemische Technologie der Nuklearen Entsorgung; Technische Hochschule Aachen (Germany, F.R.)). Aug 1987. 170p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752259/JAW.

This work examines the influence of middle active waste on the hydration of cement. The change of the mechanical and physical capacities of the MAW contained products is also analysed. Experiments were performed to determine if cesium and strontium are bounded in the hydration products of cement. The hydration of cement changes with the content of NaNO/sub 3/ in the MAW, and it also changes with the acidity of the middle active waste. The MAW was fixed in its acid form and neutralized with NaOH. The increasing of the NaNO/sub 3/ content of the MAW and the neutralization of the acid MAW, reduced the hydration of C/sub 3/S and C/sub 3/A. The decontamination substances of the MAW reacted by decreasing and increasing on the C/sub 3/S and C/sub 3/A hydration. The reaction depends on the type of cement and acidity of MAW. The experiments gave informations about the resistance to dissoluton of NaNO/sub 3/ in the MAW that is fixed in cement samples and indicated that blast furnace slag cement has the highest resistance against 60/sup 0/C water or salt water leaching. The SEM analytic shows that neither cesium nor strontium is bounded in the hydration products of the cement, during the hydration of the MAW cement mixture. Both crystallize in pores, cesium as CsNO/sub 3/ and strontium as SrSO/sub 4/.

17785 (KFK—4177, pp 68-80) **New results from the research and development work of the Institute for Nuclear Fuel Treatment Technology (INE).** Krause, H. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Nukleare Entsorgungstechnik). Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

The work of the Institute for Nuclear Fuel Treatment Technology (INE) is used for the development and improvement of the processes for the treatment of radioactive waste and for fixing radioactive residues. Further, contributions are made to characterising the binding of waste and its behaviour in final storage conditions. There are reports here on the bitumenising of liquid concentrates (behaviour under thermal loading), investigations on cement products (chemical reactions, leaching) work on the separation of long term and transuranic nuclides from liquid waste, wet ashing of combustible waste containing Pu and finally, on work for the vitrification of highly active waste, the latter with regard to the vitrification technique to be used at the Wackersdorf reprocessing plant.

17786 (KFK—4177, pp 135-147) **Vitrification of highly radio-active fission product solutions in a directly heated ceramic smelter.** Hoehlein, G.; Weisenburger, S.; Wiese, H. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R.; Deutsche Gesellschaft fuer Wiederaufarbeitung von Kernbrennstoffen m.b.H., DWK, Hannover, Germany, F.R.). Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

The erection of the pilot plant at Mol for producing waste capable of being stored (PAMELA) at the EUROCHEMIC reprocessing plant site at Mol in Belgium was completed in 1984. After a year of cold test operation with simulated waste solution, the plant was set to work hot on October 1, 1985. There is a report on experience gained in the vitrification of highly radioactive waste solution.

17787 (KFK—4177, pp 148-185) **Chemistry of the vitrification of HLW.** Pentinghaus, H. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Nukleare Entsorgungstechnik). Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

The process provided for the vitrification of highly radioactive waste solutions from the planned Wackersdorf reprocessing plant is a single stage smelting process, based on a ceramic smelting furnace fed with liquid, using boron silicate glass waste. In order to produce high quality products and to understand the processes in technical processing, technical vitrification experiments were carried out with a fully simulated HLW product. This is a report on the basis of vitrification, the processes which have an adverse effect on the product quality (such as agglomeration of non-dissolved materials, the occurrence of a yellow phase and deposits of precious metal compounds) and on the quantification of the mechanical and chemical processes determining the vitrification process (mechanics of smelting, intermediate salt melts, degree of loading, behaviour of precious metals, volatility of oxygen and its effect).

17788 (KFK—4177, pp 186-208) **Development and active demonstration of the process of wet ashing of combustible waste containing plutonium.** Wieczorek, H.; Oser, B. Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

The plant for Pu wet ashing developed by the Institute for Nuclear Fuel Treatment at the Karlsruhe Nuclear Research Centre (KfK) was used in a joint EUROCHEMIC/KfK project. In the wet ashing of 800 kg of waste and the recovery of 6.3 kg of plutonium, the suitability of the process and the plant components for treating combustible waste containing a great deal of plutonium was proved. High throughput rates of waste and plutonium were achieved with the reactor specially designed for this process. There are reports on the construction of the plant, the materials used and their behaviour, the distribution of alpha particle activity in the process flows and the decontamination factors of the individual components, the waste products including secondary waste and the faults occurring in operation.

17789 (KFK—4177, pp 257-292) **Fixing and storage of fission krypton in metals.** Fritsch, T.; Henrich, E.; Roemer, J. Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

The fixing of krypton in ion atomizer pumps is the only conditioning process so far, which manages without high pressure, without high temperature and without the accumulation of unfixed krypton in all stages and therefore pays special attention to safety. The product is a compact piece of metal and can be stored directly in the used pumps without pressure. The outer pump bodies form a 2nd containment. The shape and volume of the used pumps is comparable with about 20 bar pressurized gas bottles. The important results of the laboratory work orientated towards applications are described and so is the development of atomizer pumps with suitable storage metals and optimum working conditions. The Kr metal products are characterized as regards storage density, storage shape and thermal, mechanical and radiolytic stability. The state of present development of atomizer pumps on the technical scale is explained.

17790 (KFK—4177, pp 387-399) **Characterisation of cemented/bituminized LAW and MAW waste products.** Vejmelka, P.; Johnsen, P.; Kluger, W.; Koester, R. Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

In the context of work for characterising low and medium activity waste products, investigations were carried out to determine the release of radioactivity from binding waste in given accidents, such as mechanical and thermal loading for the operating phase of a final store. The effects of mechanical loads on MAW cement products and the effects of thermal laods on MAW cement and MAW bitumen products were examined. The release of fine dust reaching the lungs, with a particle size of $\leqq 10$ µm from a 200 litre roller seam cement binder with a maximum mechanical load of 3x10/sup 5/ Nm covering the accident case is about 1.5 g and therefore corresponds to $\approx$ 10/sup -4/% of the total radio-activity inventory for homogeneous products. With thermal loading (60 minute oil fire, 800/sup 0/C) $\approx$ 10/sup -3/% of the radioactivity inventory is released via the release of water from the waste binder. The activity release of MAW bitumen products containing NaNO/sub 3/ (175 litre drum) with thermal load is considerably higher, as due to the NaNO/sub 3/ content of the products, after an induction period of about 20 minutes there is an exothermal reaction between the bitumen and the NaNO/sub 3/, which leads to burning of the bitumen with considerable aerosol formation. The Na losses are about 32% and the Pu losses, derived from the results of laboratory experiments with samples containing Eu and Pu and samples containing Eu on the original size, are only 15% maximum, even with complete burn up. It was shown for all the investigations with samples of the original size that the effects of the load cases considered can be reduced or completely avoided by additional packing (concrete shielding).

17791 (KFK—4177, pp 442-448) **Process monitoring system for the V-W1 vitrification plant.** Fromm, R.; Holler, E. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Datenverarbeitung in der Technik). Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

The process monitoring system described here provides an instrument which should make it possible for the operator to operate the process of simulated vitrification in the best possible way. In particular, the parameters important for process control should be represented at the right time in the right form (helping the operator), in order to prevent wrong operation and late intervention in the process. The used of this sytem should also be able to use it in order to be able to analyse time delayed processes and so to obtain a more exact view of the behaviour of this process.

17792 (PNL—6334) **Melter viewing system for liquid-fed ceramic melters.** Westsik, J.H. Jr.; Brenden, B.B. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1988. Contract AC06-76RL01830. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88005323/JAW.

Melter viewing systems are an integral component of the monitoring and control systems for liquid-fed ceramic melters. The Pacific Northwest Laboratory (PNL) has designed cameras for use with glass melters at PNL, the Hanford Waste Vitrification Plant (HWVP), and West Valley Demonstration Project (WVDP). This report is a compilation of these designs. Operating experiences with one camera designed for the PNL melter are discussed. A camera has been fabricated and tested on the High-Bay Ceramic Melter (HBCM) and the Pilot-Scale Ceramic Melter (PSCM) at PNL. The camera proved to be an effective tool for monitoring the cold cap formed as the feed pool developed on the molten glass surface and

for observing the physical condition of the melter. Originally, the camera was built to operate using the visible light spectrum in the melter. It was later modified to operate using the infrared (ir) spectrum. In either configuration, the picture quality decreases as the size of the cold cap increases. Large cold caps cover the molten glass, reducing the amount of visible light and reducing the plenum temperatures below 600°C. This temperature corresponds to the lowest level of blackbody radiation to which the video tube is sensitive. The camera has been tested in melter environments for about 1900 h. The camera has withstood mechanical shocks and vibrations. The cooling system in the camera has proved effective in maintaining the optical and electronic components within acceptable temperature ranges. 10 refs., 15 figs.

17793 **(PNL-SA—14663) Analysis of spent fuel as a nuclear waste form.** Apted, M.J.; Liebetrau, A.M.; Engel, D.W. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1987. Contract AC06-76RL01830. 29p. (CONF-870306—72). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005133/JAW.

From Waste management '87; Tucson, AZ, USA (1 Mar 1987).

The release of radionuclides from spent fuel has been simulated for three different repository sites and waste package designs. Five distinct distributions for containment failure have been considered, and the release of nuclides from the UO_2 matrix, gap (including grain boundary), crud/surface layer, and cladding has been calculated with the AREST code. Separate scenarios involving incongruent and congruent release from the UO_2 matrix have also been examined. Releases for individual radionuclides have been evaluated relative to compliance with allowable NRC fractional release rates and EPA 10,000-year cumulative release limits. For the congruent matrix release scenario, spent fuel meets all EPA and NRC release criteria for all cases in which distributed containment failures are assumed. However, for the incongruent matrix release scenario, releases of several nuclides, notably Cs-135 and I-129, are found to be above their NRC limits. Additional studies, especially to determine whether release of nuclides from UO_2 is congruent or not, are needed before these general conclusions can be further substantiated.

17794 **(PNL-SA—15135) Special waste-form lysimeters: Arid.** Jones, T.L.; Serne, R.J. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. Contract AC06-76RL01830. 16p. (CONF-870859—30). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005125/JAW.

From 9. annual low-level radioactive waste management program conference; Denver, CO, USA (25 Aug 1987).

The release of contaminant from solidified low-level waste forms is being studied in a field lysimeter facility at the Hanford Site in southeastern Washington State. Duplicate samples of five different waste forms have been buried in 10 lysimeters since March 1984. Waste-form samples represent three different waste streams and four solidification agents (masonry cement, Portland III cement, Dow polymer /sup (a)/, and bitumen). Most precipitation at the Hanford Site arrives as winter snow; this contributes to a strong seasonal pattern in water storage and drainage observed in the lysimeters. The result is an annual range in the volumetric soil water content from 11% in late winter to 7% in the late summer and early fall, as well as annual changes in pore water velocities from approximately 1 cm/wk in early spring to less than 0.05 cm/wk in early fall. Measurable quantities of tritium and cobalt-60 are being collected in lysimeter drainage water. Approximately 30% of the original tritium inventory has been leached from two lysimeters originally containing tritium. Cobalt-60 is present in all waste forms; it is being collected in the leachate from five lysimeters. The total amount released varies, but in each case it is less than 0.1% of the original cobalt inventory of the waste sample. Nonradioactive constituents contained in the waste form, such as sodium, boron, and sulfate, are also being leached.

17795 **(RFP—4008) Americium removal from nitric acid waste streams.** Muscatello, A.C.; Navratil, J.D. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1986. Contract AC04-76DP03533. 10p. (CONF-860411—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005140/JAW.

From 1. international conference on separations science and technology; New York, NY, USA (15 Apr 1986).

Separations research at the Rocky Flats Plant (RFP) has found ways to significantly improve americium removal from nitric acid (7M) waste streams generated by plutonium purification operations. Partial neutralization of the acid waste followed by solid supported liquid membranes (SLM) are useful in transferring and concentrating americium from nitrate solutions. Specifically, DHDECMP (dihexyl-N,N-diethylcarbamoylmethylphosphonate) supported on Accurel polypropylene hollow fibers assembled in modular form transfers >95% of the americium from high nitrate (6.9M), low acid (0.1M) feeds into 0.25M oxalic acid stripping solution. Maximum permeabilities were observed to be 0.001 cm/sec, consistent with typical values for other systems. The feed:strip volume ratio shows an inverse relationship to the fraction of metal ion transferred. Cation exchangers may be used to concentrate americium from the strip solution. Furthermore, O0D (iB)CMPO (or CMPO) (octylphenyl-N-N-diisobutylcarbamoylmethylphosphine oxide) has been tested in an extraction chromatography mode. Preliminary results show CMPO to be effective in removing americium if the feed is neutralized to 1.0M acidity and iron(III) is complexed with 0.20M oxalic acid. 3 figs.

17796 **ORIGEN-S (α,n) neutron source spectra in borosilicate glass containing HLW.** Hermann, O.W.; Parks, C.V.; Ludwig, S.B. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **54**: 63-65(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

There is growing interest in the methodology and computational software for evaluating the (α,n) source spectra produced in mixtures of high-level waste (HLW) and borosilicate glass. The need for this development has been seen in previous work involving the analysis of HLW in borosilicate glass. Descriptions and applications of the ORIGEN-S method of computing neutron source spectra by both (α,n) reactions and spontaneous fission of UO_2 spent fuel have been reported previously. This summary presents a significant expansion of the ORIGEN-S (α,n) model to include alpha interactions with the light elements of borosilicate glass. The Battelle/Office of Nuclear Waste Isolation requested this model extension. There is an associated interest in the use of Oak Ridge National Lab. shielding codes for analyzing HLW systems.

17797 **Design of saltstone vaults.** Aiyar, G.S.; Hsiu, F.J. *Transactions of the American Nuclear Society;* **54**: 79(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

Radioactive waste from processed spent nuclear fuel at the Savannah River Plant, South Carolina, are stored in underground tanks. The wastes consist of sludge and supernate. Most of the radionuclides and some nonradioactive constituents are removed from the supernate. These along with the sludge are converted into a glass-crystallite matrix and cast into stainless steel cansisters for future disposal in a geological repository. The decontaminated salt solution is mixed with cement, fly ash, and a set-retarding agent, and the resulting grout is transferred to reinforced concrete vaults where it sets into a monolith termed saltstone. The vault is then capped with concrete. A total of 21 vaults measuring 600 x 100 x 27 ft are planned for disposal of the existing supernate plus any additional supernate generated up to the year 2000.

17798 **(AERE-R—12291) Gas generation in repositories.** Biddle, P.; Rees, J.H.; McGahan, D.; Rushbrook, P.E. (UKAEA Harwell Lab. Environmental and Medical Science Div.). Sep 1987. 73p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751912/JAW.

The nature and quantities of gases likely to be produced by various processes in repositories for low level and intermediate level radioactive wastes are examined in this preliminary study. Many simplifying assumptions are made where published or experimental data is unavailable. The corrosion of the canisters and metallic components in wastes is likely to be the major gas production process in both types of repository. A significant contribution from microbiological activity is expected to occur in low level repositor-

ies, predominantly where no cement grouting of the cans has been carried out. A number of areas for further research, required before a more comprehensive study could be carried out, have been identified.

17799 **(ARH—2437-R) Waste Management Special Studies: Progress report No. 16, August-September 1974.** Nelson, D.C.; Bowers, E.M. (comp.). (Atlantic Richfield Hanford Co., Richland, WA (USA)). Oct 1974. Contract AM06-76RL02130. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004622/JAW.

This document is one of a series of bimonthly status reports that describe the planning and design phases for an engineered extended storage facility for radioactive wastes generated at the Hanford Plant. This report describes further refinement of the basic facility design, projected environmental impacts of a ruptured cask, and the initiation of studies to include transuranic wastes in this facility. 11 refs. (TEM)

17800 **(BMI/OCRD—28) Solutions to HYDROCOIN [Hydrologic Code Intercomparison] Level 1 problems using STOKES and PARTICLE (Cases 1,2,4,7).** Gureghian, A.B.; Andrews, A.; Steidl, S.B.; Brandstetter, A. (Battelle Memorial Inst., Columbus, OH (USA). Office of Crystalline Repository Development). Oct 1987. Contract AC02-83CH10139. 149p. NTIS, PC E07/MF A01; 1; GPO Dep. Order Number DE88005575/JAW.

HYDROCOIN (Hydrologic Code Intercomparison) Level 1 benchmark problems are solved using the finite element groundwater flow code STOKES and the pathline generating code PARTICLE developed for the Office of Crystalline Repository Development (OCRD). The objective of the Level 1 benchmark problems is to verify the numerical accuracy of ground-water flow codes by intercomparison of their results with analytical solutions and other numerical computer codes. Seven test cases were proposed for Level 1 to the Swedish Nuclear Power Inspectorate, the managing participant of HYDROCOIN. Cases 1, 2, 4, and 7 were selected by OCRD because of their appropriateness to the nature of crystalline repository hydrologic performance. The background relevance, conceptual model, and assumptions of each case are presented. The governing equations, boundary conditions, input parameters, and the solution schemes applied to each case are discussed. The results are shown in graphic and tabular form with concluding remarks. The results demonstrate the two-dimensional verification of STOKES and PARTICLE. 5 refs., 61 figs., 30 tabs.

17801 **(DOE/NV/10384—19) Hydrologic utility of borehole temperatures in Areas 19 and 20, Pahute Mesa, Nevada Test Site.** Pottorff, E.J.; Erikson, S.J.; Campana, M.E. (Nevada Univ., Reno (USA). Water Resources Center). Aug 1987. Contract AC08-85NV10384. 195p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88003906/JAW.

Borehole temperature logs from Areas 19 and 20 of the Nevada Test Site were examined in an attempt to obtain quantitative information on the hydrologic regime of Pahute Mesa. A qualitative assessment of the logs proved useful for identifying borehole static water levels and areas of water influx into the borehole. However, the uncertain quality of the data and the effects of borehole convection rendered the data of little value for quantitative hydrologic analysis. The presence of borehole convection suggests that the borehole thermal profile is not truly representative of the thermal regime in the adjacent porous medium. Static water levels were corrected for the effects of temperature; differences between corrected and uncorrected water levels range from 0.03 to 49.65 feet. Corrected water levels provide more accurate estimates of hydraulic heads, which in turn provide more accurate estimates of groundwater flow velocities and radionuclide transport. Although the corrections were limited to data from Areas 19 and 20, future groundwater studies on the Nevada Test Site should be cognizant of temperature effects on hydraulic heads, lest erroneous conclusions result. 21 refs., 45 figs., 6 tabs.

17802 **(DOE/RL—87-09) The Remedial Action Priority System (RAPS): Mathematical formulations.** Whelan, G.; Strenge, D.L.; Droppo, J.G. Jr.; Steelman, B.L.; Buck, J.W. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. Contract AC06-76RL01830. 323p. NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE88001699/JAW.

The Remedial Action Priority System (RAPS) represents a methodology that prioritizes inactive hazardous and radioactive mixed-waste disposal sites in a scientific and objective manner based on limited site information. This methodology is intended to bridge the technology gap between the initial site evaluation using the Hazard Ranking System (HRS) and the time-consuming process of actual field site characterization, assessment, and remediation efforts. The RAPS methodology provides the US Department of Energy with a management tool for assistance in prioritizing funding and human resource allocations for further investigations and possible remediations at its inactive waste sites. Use of RAPS will help DOE ensure that those sites posing the highest potential risk are addressed first. Chapters 1 through 10 were processed separately for the Energy Data Base.

17803 **(DOE-RW—87.063) Natural analogues and radionuclide transport model validation.** Lever, D.A. (Department of the Environment, London (UK); UKAEA Harwell Lab. Theoretical Physics Div.). Aug 1987. 9p. (AERE-TP—1234). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752351/JAW.

In this paper, some possible roles for natural analogues are discussed from the point of view of those involved with the development of mathematical models for radionuclide transport and with the use of these models in repository safety assessments. The characteristic features of a safety assessment are outlined in order to address the questions of where natural analogues can be used to improve our understanding of the processes involved and where they can assist in validating the models that are used. Natural analogues have the potential to provide useful information about some critical processes, especially long-term chemical processes and migration rates. There is likely to be considerable uncertainty and ambiguity associated with the interpretation of natural analogues, and thus it is their general features which should be emphasized, and models with appropriate levels of sophistication should be used. Experience gained in modelling the Koongarra uranium deposit in northern Australia is drawn upon.

17804 **(DOE/RW—0145-2) Quarterly report on program cost and schedule: Fourth quarter FY 1987.** (USDOE Office of Civilian Radioactive Waste Management, Washington, DC). 1987. 45p. Office of Civilian Radioactive Waste Management, USDOE RW-40, Washington, DC 20585. Order Number TI88005071/JAW.

This report is intended to provide a summary of the cost and schedule performance for the Civilian Radioactive Waste Management program. Performance data are presented for each of the major program elements. Also included in this report is the status of the Nuclear Waste Fund revenues and disbursements. This report includes performance data through September 1987.

17805 **(DP-MS—86-143-Rev.1) Large-scale demonstration of waste solidification in saltstone.** McIntyre, P.F.; Oblath, S.B.; Wilhite, E.L. (Savannah River Lab., Aiken, SC (USA)). May 1988. Contract AC09-76SR00001. 24p. (CONF-870511—5-Rev.1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004792/JAW.

From 4. international hazardous waste symposium on environmental aspects of stabilization-solidification of hazardous and radioactive wastes; Atlanta, GA, USA (3 May 1987).

The saltstone lysimeters are a large scale demonstration of a disposal concept for decontaminated salt solution resulting from in-tank processing of defense waste. The lysimeter experiment has provided data on the leaching behavior of large saltstone monoliths under realistic field conditions. The results also will be used to compare the effect of capping the wasteform on contaminant release. Biweekly monitoring of sump leachate from three lysimeters has continued on a routine basis for approximately 3 years. An uncapped lysimeter has shown the highest levels of nitrate and ^{99}Tc

release. Gravel and clay capped lysimeters have shown levels equivalent to or slightly higher than background rainwater levels. Mathematical model predictions have been compared to lysimeter results. The models will be applied to predict the impact of saltstone disposal on groundwater quality. 9 refs., 5 figs., 3 tabs.

17806 **(DP-MS—87-85) Inhibition of nuclear waste solutions containing multiple aggressive anions.** Congdon, J.W. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 14p. (CONF-880314—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87014434/JAW.

From National Association of Corrosion Engineers meeting; St. Louis, MO, USA (21 Mar 1988).

The inhibition of localized corrosion of carbon steel in caustic, high-level radioactive waste solutions was studied using cyclic potentiodynamic polarization scans, supplemented by partially immersed coupon tests. The electrochemical tests provided a rapid and accurate means of determining the relationship between the minimum inhibitor requirements and the concentration of the aggressive anions in this system. Nitrate, sulfate, chloride, and fluoride were identified as aggressive anions, however, no synergistic effects were observed between these anions. This observation may have important theoretical implications because it tends to contradict the behavior of aggressive anions as predicted by existing theories for localized corrosion. 10 refs., 5 figs., 2 tabs.

17807 **(DPST—85-707) Environmental information document: Reactor Seepage Basins.** Pekkala, R.O.; Jewell, C.E.; Holmes, W.G.; Marine, I.W. (Savannah River Lab., Aiken, SC (USA)). Mar 1987. Contract AC09-76SR00001. 163p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88003759/JAW.

This document provides environmental information on postulated closure options for the inactive Reactor Seepage Basins at the Savannah River Plant and was developed as background technical documentation for the Department of Energy's proposed Environmental Impact Statement (EIS) on waste management activities for groundwater protection at the plant. The results of groundwater and atmospheric pathway analyses, accident analysis, and other environmental assessments discussed in this document are based upon a conservative analysis of all foreseeable scenarios as defined by the National Environmental Policy Act. The closure options considered for the Reactor Seepage Basins are waste removal and closure, no waste removal and closure, and no action. The predominant pathways for human exposure to chemical and/or radioactive constituents are through surface, subsurface, and atmospheric transport. Modeling calculations were made to determine the risks to human population via these general pathways for the three postulated closure options. An ecological assessment was conducted to predict the environmental impacts on aquatic and terrestrial biota. The relative costs for each of the closure options was estimated. 35 refs., 24 figs., 64 tabs.

17808 **(EGG—2525) Annual technology assessment and progress report for the Buried Transuranic Waste Studies Program at the Idaho National Engineering Laboratory (1987).** Loomis, G.G.; Low, J.O. (EG and G Idaho, Inc., Idaho Falls (USA)). Jan 1988. Contract AC07-76ID01570. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005490/JAW.

This report presents FY-87 activities for the Buried Transuranic (TRU) Waste Studies Program at the Idaho National Engineering Laboratory (INEL). This program investigates techniques to provide long-term confinement of buried TRU waste, as well as methods of retrieval. The confinement method of in situ grouting was examined in a simulated shallow-land buried TRU waste pit constructed adjacent to the RWMC TRU waste burial pits. The in situ grouting technique involved an experimental dyanmic compaction process which simultaneously grouts and compacts the waste. The simulated waste pit consisted of regions of randomly dumped drums, stacked boxes, and stacked drums, thus representing the various conditions of buried waste at the RWMC. Simulated waste and airborne tracers were loaded into the various simulated buried waste containers. Pregrouting and post-grouting data, such as hydraulic conductivity, were obtained to assess the hydrological integrity of the grouted waste material. In addition, post-grouting destructive examinations were performed and the results analyzed. Retrieval and processing of the TRU buried waste is also being examined at the INEL. At a conceptual level, retrieval of TRU buried waste involves a movable containment building to confine airborne particulate, heavy equipment to remove the waste, processing equipment, and equipment to control the air quality within the building. Studies were performed in FY-87 to identify containment building requirements such as type, mobility, and ventilation. An experimental program to demonstrate the retrieval technique using existing INEL heavy equipment has also been identified. 11 refs., 17 figs., 11 tabs.

17809 **(IAEA-WMRA—17) Waste management research abstracts No. 17. Information on radioactive waste programmes in progress.** (International Atomic Energy Agency, Vienna (Austria)). Nov 1986. 453p. NTIS (US Sales Only), PC A20/MF A01. Order Number DE88701296/JAW.

The research data sheets contained in this issue have been collected during the period ending August 1986, and reflect research currently in progress in the field of radioactive waste management. This publication covers a wide range of programmes in the IAEA Member States. Abstracts intended for inclusion in this publication were submitted in the English, French, Russian or Spanish language.

17810 **(INIS-mf—11635) Method for the determination of the retention capacity of backfill materials and seals for gaseous radionuclides. Final report.** Beyer, H.; Beck, R.; Both, H.; Haas, E.; Eigenwillig, G.; Doerfelt, R.D. (Kraftwerk Union A.G., Erlangen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1987. 56p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752253/JAW.

With the aid of radioindicator technology, the retention capacity of two backfill materials (iron ore and country rock) for the gases CH/sub 4/, CO, CO/sub 2/ (all /sup 14/C), HT, HTO, /sup 131/I/sub 2/, CH/sub 3//sup 131/I, /sup 85/Kr and /sup 222/Rn and was determined by performing fixed bed column experiments. In the experiments, iodine was converted to iodide and bound to the backfill materials obtained from the Konrad mine (R $>$ 3x10/sup 4/). HTO and /sup 14/CO/sub 2/ passed through the backfill material bed with a time delay. The other indicators showed no interaction with the backfill material. In addition to the retardation factors (R), the effective diffusion coefficients (D) were also determined. For all indicators, this value was in the range 0.16 cm/sup 2//s to 0.42 cm/sup 2//s. With 10 refs., 9 tabs., 4 figs..

17811 **(LBL—23973) Comments on model validation.** Tsang, Chin-Fu. (Lawrence Berkeley Lab., CA (USA)). Jul 1987. Contract AC03-76SF00098. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004894/JAW.

The paper points out the importance and usefulness of recognizing the separate roles of processes and geometric structures in predictive modeling of the performance of a nuclear waste repository or underground injection disposal of toxic wastes. Based on this a validation procedure is proposed. Furthermore, two stages and three elements of validation are described and discussed. Finally, comments are made on the choice of measurables to be used to compare modeling results and field data in the validation procedure. 8 refs.

17812 **(ORNL/TM—10567) Mineralogical characterization of selected shales in support of nuclear waste repository studies: Progress report.** Lee, S.Y.; Hyder, L.K.; Alley, P.D. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006151/JAW.

Because baseline characterization of shale mineralogy is critical to the interpretation of results from experiments on radionuclide retardation, groundwater-shale interactions, and physicochemical characteristics, a protocol for quantitative mineralogical analyses has been developed by integrating geochemical and instrumental techniques for the investigation of properties related to repository performance. Thermal analyses were used to estimate total organic

matter and carbonate mineral contents. Scanning electron microscope backscattering and elemental mapping of polished sectors and particle-size distribution data were used to estimate the amounts of quartz plus feldspar and pyrite in the shales. X-ray diffraction, neutron activation, and size-distribution data were utilized to estimate phyllosilicate mineral contents. High-resolution transmission electron microscopy was used to identify clay mineral components.

17813 **(ORNL/TM—10634) Geochemical behavior of Cs, Sr, Tc, Np, and U in saline groundwaters: Sorption experiments on shales and their clay mineral components: Progress report.** Meyer, R.E.; Arnold, W.D.; Ho, P.C.; Case, F.I.; O'Kelley, G.D. (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88003643/JAW.

The Sedimentary Rock Program at the Oak Ridge National Laboratory is investigating shale to determine its potential suitability as a host rock for the disposal of high-level radioactive wastes (HLW). In support of this program, preliminary studies were carried out on sorption of cesium, strontium, technetium, neptunium, and uranium onto Chattanooga (Upper Dowelltown), Pierre, Green River Formation, Nolichucky, and Pumpkin Valley Shales under oxic conditions (air present). Three simulated groundwaters were used. One of the groundwaters was a synthetic brine made up to simulate highly saline groundwaters in the Pumpkin Valley Shale. The second was a 100/1 dilution of this groundwater and the third was 0.03 M $NaHCO_3$. Moderate to significant sorption was observed under most conditions for all of the tested radionuclides except technetium. Moderate technetium sorption occurred on Upper Dowelltown Shale, and although technetium sorption was low on the other shales, it was higher than expected for Tc(VII), present as the anion TcO_4^-. Little sorption of strontium onto the shales was observed from the concentrated saline groundwater. These data can be used in a generic fashion to help assess the sorption characteristics of shales in support of a national survey. 10 refs., 4 figs., 23 tabs.

17814 **(PER—143) Summary of the geotechnical and environmental investigations pertaining to the Vaalputs national radioactive waste disposal facility.** Hambleton-Jones, B.B.; Levin, M.; Camisani-Calzolari, F.A.G.M. (Nuclear Development Corp. of South Africa (Pty.) Ltd., Pelindaba, Pretoria). Aug 1986. 156p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701402/JAW.

This report describes the geological environmental surveys that lead to the choice and final evaluation of the Vaalputs national facility for the disposal of radioactive waste. This survey looked at the geography, demography, ecology, meteorology, geology, geohydrology and background radiological characteristics of the Vaalputs radioactive waste facility.

17815 **(PER—151) Geology of the Vaalputs radioactive waste disposal site in the Republic of South Africa. Explanatory notes for the geological map of the site on the scale 1:25 000.** Andreoli, M.A.G.; Andersen, N.J.B.; Levin, M.; Niemand, N. (Nuclear Development Corp. of South Africa (Pty.) Ltd., Pelindaba, Pretoria). Jan 1987. 48p. (GEA—720). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701403/JAW.

The Vaalputs site is underlain by an extensive veneer of Tertiary and Quaternary deposits covering a crystalline basement of Precambrian age. The geological history of the area, from the oldest to the youngest event, may be summarized as follows: 1. Polyphasic ductile/ductile-brittle deformation and 1 100 Ma old granulite facies metamorphism of a (volcano) sedimentary sequence, and of associated syntectonic to late-tectonic granitic and basic intrusions. 2. Deposition of glacial tillite after a long erosional hiatus in Karoo (Permian) times. The preservation of these rocks is limited to down-faulted structural blocks within the area investigated. 3. Lower Tertiary rejuvenation of older faults and shear zones, accompanied by kimberlitic volcanism, resulted in the uplift of the Kamiesberge mountain range west of the site. Intense erosion of these mountains shed abundant detritus, which accumulated in tectonically controlled troughs and fans. 4. From ca. 25 Ma ago to the Present, tectonic stability and (semi)arid conditions have generally prevailed, leading to an extensive thin cover of calcrete and windblown Kalahari sands. The unfaulted, highly impermeable nature of the Vaalputs formation renders it very suitable for the safe disposal of low- to medium-level radioactive waste in the area selected. However, the numerous faults and shear zones in the granitic and gneissic basement will need in-depth investigations should a high-level radwaste repository be required.

17816 **(SAND—86-1955) Proposed preliminary definition of the disturbed-zone boundary appropriate for a repository at Yucca Mountain.** Langkopf, B.S. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1987. Contract AC04-76DP00789. 112p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005248/JAW.

Some of the calculations that support the licensing of a repository for high-level radioactive waste will use the regulatory concept of a disturbed zone. The Nevada Nuclear Waste Storage Investigations (NNWSI) project must determine the location of the boundary of the disturbed zone for use in these calculations. This paper summarizes results of computer analyses and laboratory experiments and suggests a preliminary definition for the boundary of the disturbed zone for the unsaturated environment at Yucca Mountain. Although the intent of this paper is to define the boundary of the disturbed zone at the edge of significant changes in intrinsic hydrologic properties, there is no evidence of changes in intrinsic hydrologic properties that could significantly change the groundwater travel time from the repository to the water table. Such a result suggests that the disturbed zone at Yucca Mountain is of minimal extent. Because the analyses and experiments reviewed here indicate that there are a variety of changes near the waste package and because the results are subject to uncertainty, the preliminary suggestion for the extent of the disturbed zone is a value larger than the results themselves would suggest: the boundary is proposed to be a plane 10 m below the lower boundary of the waste packages. 88 refs., 12 figs., 5 tabs.

17817 **(SAND—86-2125C) Demonstration of a performance assessment methodology for nuclear waste isolation in basalt formations.** Bonano, E.J.; Davis, P.A. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 19p. (CONF-880201—6). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005253/JAW.

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

This paper summarizes the results of the demonstration of a performance assessment methodology developed by Sandia National Laboratories, Albuquerque for the US Nuclear Regulatory Commission for use in the analysis of high-level radioactive waste disposal in deep basalts. Seven scenarios that could affect the performance of a repository in basalts were analyzed. One of these scenarios, normal ground-water flow, was called the base-case scenario. This was used to demonstrate the modeling capabilities in the methodology necessary to assess compliance with the ground-water travel time criterion. The scenario analysis consisted of both scenario screening and consequence modeling. Preliminary analyses of scenarios considering heat released from the waste and the alteration of the hydraulic properties of the rock mass due to loads created by a glacier suggested that these effects would not be significant. The analysis of other scenarios indicated that those changing the flow field in the vicinity of the repository would have an impact on radionuclide discharges, while changes far from the repository may not be significant. The analysis of the base-case scenario was used to show the importance of matrix diffusion as a radionuclide retardation mechanism in fractured media. The demonstration of the methodology also included an overall sensitivity analysis to identify important parameters and/or processes. 15 refs., 13 figs., 2 tabs.

17818 **(SAND—86-2527, pp 1-3) Introduction.** May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

The report of the Physical Oceanography and Water Column Geochemistry (POWCG) Studies Group of the Subseabed

Disposal Project (SDP) for FY85 (October 1984 through September 1985) to termination of the POWCG contractors' work in May 1986 is presented. The POWCG has analyzed samples and data collected during the Nares I Mission to the Nares Abyssal Plain; held a planning meeting to develop a six-year research plan for the Nares Abyssal Plain; and planned and stages a second interdisciplinary (physical oceanography, water column geochemistry, environmental modeling, and biology) mission (November 1985) to the Nares Abyssal Plain. The POWCG Studies Group, the Biological Oceanography (BO) Group, and the Environmental Modeling (EM) Group comprise the Environmental Studies Group, whose are of responsibility is the environmental characterization of the world's oceans as they relate to subseabed disposal. The three components of the Environmental Studies Group work together to provide data required to assess radiological impact of seabed disposal on the ecosystem in general and on human beings in particular.

17819 (SAND—86-2527, pp 4) **Planning meeting for the Nares Abyssal Plain long-term research plan.** May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

Sandia National Laboratories' (SNLA) staff, contractors, and consultants met in Albuquerque, NM, on March 14 and 15, 1985, to develop plans for a six-year interdisciplinary research program at the Nares Abyssal Plain. The Nares has been selected as the site at which the SDP will validate environmental models and perform a site characterization for the 1990 status document. In addition, the Nares work will be structured so that it can be used to develop techniques and tools to efficiently and cost-effectively produce a reliable risk assessment and site characterization (including model validation) for any location likely to be selected as a potential repository site.

17820 (SAND—86-2527, pp 4-5) **Analysis of data and samples from the Nares I Oceanographic Mission.** May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

The purpose of this mission (September 19 to October 1, 1984) was to conduct an interdisciplinary reconnaissance of the Nares Region, which had at that time recently been designated a study area for the Environmental Studies Group. An overview of the results of sample and data analysis is presented. The information obtained on the Nares Mission, along with a historical summary and synthesis of the physical oceanographic observations in the region, was used as background material for developing the Nares Abyssal Plain long-term research plan.

17821 (SAND—86-2527, pp 5-6) **Mooring work.** May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

A current-meter, sediment-trap transmissometer mooring deployed in August 1983 was recovered and replaced with a similar mooring containing more sediment traps for better definition of vertical particle fluxes. The current meter data significantly increased information available about currents in the region. All information supports initial suppositions that the Nares Abyssal Plain is a relatively inactive region where nontidal current patterns are dominated by intermittant, low-frequency (mesoscale) activity.

17822 (SAND—86-2527, pp 7-9) **Hydrography.** May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

The hydrographic work consisted of conductivity, temperature, and depth (CTD) profiles, along with simultaneous light-transmission and dissolved-oxygen profiles. Measurements were made in real time and transmitted by cable to the ship's laboratory. The information was used to analyze the property structure of water in a particular region, in order to characterize sources of water found in the region and the long-term water circulation patterns (years to hundreds of years). CTD data were also used to calculate water density as a function of depth, and this information can be used at successive measurement stations in the geostrophic approximation to calculate short-term currents in a region.

17823 (SAND—86-2527, pp 9-11) **Pumping and large-volume water sampling.** May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

Pumping and large-volume water sampling are a part of the water column geochemistry program. The program's objectives are to develop and validate geochemical transport models and to assist in producing a site characterization for the Nares region. In-situ pumps are used to sample large volumes of sea water (order of 1000 ell) for reactive chemical species, specifically, naturally-occurring thorium isotopes and the artificial radionuclides Pu and ^{241}Am. Large-volume water samples (60 ell) are collected to determine dissolved Pu, ^{137}Sc, and ^{90}Sr (which are not efficiently absorbed by the MnO_2 cartridges) and for backup samples for the pumped radioisotope samples.

17824 (SAND—86-2527, pp 11-12) **Core samples.** May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

A 1.8 m gravity core was analyzed for chemical composition and for ^{235}U, ^{234}U, ^{232}Th, and ^{230}Th. The depth distribution of unsupported ^{230}Th, the isotope normally used to measure sediment accumulation rates, does not decrease regularly with depth, but shows alternating zones of high and low activity. No meaningful accumulation rate can be derived from these results. As much as 170 cm (of the 180 cm) of sediment found in the core must have been deposited relatively rapidly (over about ten thousand years), perhaps as a series of turbidite deposits separated by poorly defined periods of pelagic sedimentation.

17825 (SAND—86-2527, pp 12) **Mesoscale modeling.** May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

Modelers from Sandia National Laboratory, Albuquerque (SNLA) and Harvard University participated in the Nares mission. Data was assimilated into the Harvard-developed, regional-eddy model and the current field was forecast in real time. Real-time modeling is important for monitoring, planning, and conducting biological and other types of experiments, and for model validation.

17826 (SAND—86-2527, pp 12-14) **Nares II Oceanographic Mission (November 9 to 27, 1985).** May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

The objective of the mission was to obtain information required to complete the data set for a preliminary ecological assessment of the Nares Abyssal Plain study area. Previous work at the site provided information about the physical oceanographic and water column geochemical structure of the region. The Nares II mission gathered analogous information about important biological features such as primary productivity, zooplankton activity, water column biological fluxes, population densities of demersal scavengers, microbiology, amino acid concentration, and sediment biological activity - as well as supporting physical and geochemical data.

17827 (SAND—86-2527, pp 14) **Hydrography.** May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

Two deep conductivity, depth, and temperature profiles (CTDs) in the vicinity of the mooring and 85 (750-m) expendable bathythermographs (KBTs) were taken during the mission; 64 of the XBTs were collected in a grid pattern around the mooring. An examination of the XBT data indicated very little mesoscale activity in the upper water column (0-750 m).

17828 (SAND—86-2527, pp 14) **In situ pumping.** May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

The in-situ pumps sample large volumes of sea water for reactive chemical species, particularly the isotopes Pu, ^{241}Am, and ^{137}Cs. Nine subsurface samples were collected using battery-powered, in-situ pumps at depths between 350 and 5720 m. Five surface-water samples were collected using an onboard pumping system.

17829 (SAND—86-2527, pp 15-16) **Mooring operations.** May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

The Nares-II mooring, installed September 21, 1984, was recovered with all instrumentation on November 21, 1985 at 23°14.76'N, 64°01.75'W. Instruments recovered were upright sediment traps at 735, 1435, 2885, 3800, 4785, and 5785 m, plus inverted sediment traps at 2915 and 4815 m, and five current meters located at 750, 1450, 2900, 4800, and 5800 m. The Nares-III mooring was deployed on November 22 at 23°15.07'N, 64°02.07. This mooring contains the following instrumentation: 5 current meters at 750, 1450, 2900, 4800, and 5800 m; 2 upright sediment traps at 1435 and 4785 m; 1 inverted sediment trap at 4835 m; 7 passive chemical monitors (an experimental system for long-term radionuclide collection by absorption in situ at 750, 1285, 2000, 2900, 3900, 4635, and 5800 m); and 3 transmissometers at 1450, 4800, and 5800 m. This mooring was recovered on November 3, 1986.

17830 (SAND—86-2527, pp 16) **Radon analysis.** May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

The level of excess ^{222}Rn in near-bottom waters was measured as an index of the vertical diffusivity in the benthic mixed layer. ^{222}Rn, an inert, naturally-occurring radioactive gas, is produced form the decay of ^{226}Ra in sediment and sea water. Near the bottom, concentrations of ^{222}Rn are above those attributable to decay of dissolved Ra because of radon diffusion from the bottom sediments. The distribution of this excess radon can be used to calculate the rate of vertical mixing of bottom waters.

17831 (SAND—86-2527, pp 16-20) **Biological measurements program.** May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

The flux of organic carbon to the sediment was estimated using short-term moored sediment raps located 10 m and 95 m above the sediment surface. Sediment particles were obtained from these traps for gravimetric, elemental, and isotopic analyses. These analyses provide data about the total flux of material to the sediment and also the organic carbon and total nitrogen flux to the sediment. Two box cores were obtained which were used to provide: (1) pore water nutrient and dissolved free amino acid content; (2) down core profiles of organic carbon and nitrogen; (3) bacterial counts and growth rates; (4) down core meiofaunal biomass and sensitivities; (5) down core water content. Four primary productivity stations were made to determine the rate at which organic material is photosynthetically produced by phytoplankton in the waters surrounding the Nares Abyssal Plain study area. Zooplankton studies were also conducted during the cruise.

17832 **(SAND—87-3022C) Analytical electron microscopy of leached layers on synthetic basalt glass.** Murakami, T.; Ewing, R.C.; Bunker, B.C. (Sandia National Labs., Albuquerque, NM (USA); New Mexico Univ., Albuquerque (USA). Dept. of Geology). 1987. Contract AC04-76DP00789. 14p. (CONF-871124—61). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005335/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Analytical electron microscopy was used to characterize leached layers formed on a synthetic basalt glass after 300 days in deionized water, sodium chloride solutions, or sodium chloride solutions containing magnesium chloride. Ultramicrotomed cross-sections show that the leached layers consist of a mixture of amorphous and crystalline phases whose composition and microstructure are sensitive to solution chemistry. In general, Na, Ca and Mg are selectively leached in all solutions, leaving behind surface alteration products which are rich in Fe, Ti, and Al. In deionized water and the NaCl solution, gibbsite ($Al(OH)_3$) is a major phase; in the Mg-containing solution, Si and Al are retained as smectite clays. Results are compared to the alteration of natural basalt glasses in marine environments, particularly as they relate to the use of basalt glass alteration as a means of verifying the long-term leaching behavior of nuclear waste form borosilicate glasses. 32 refs., 4 figs., 4 tabs.

17833 **(UCID—21044) Progress report on the results of testing advanced conceptual design metal barrier materials under relevant environmental conditions for a tuff repository.** McCright, R.D.; Halsey, W.G.; Van Konynenburg, R.A. (Lawrence Livermore National Lab., CA (USA)). Dec 1987. Contract W-7405-ENG-48. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005272/JAW.

This report discusses the performance of candidate metallic materials envisioned for fabricating waste package containers for long-term disposal at a possible geological repository at Yucca Mountain, Nevada. Candidate materials include austenitic iron-base to nickel-base alloy (AISI 304L, AISI 316L, and Alloy 825), high-purity copper (CDA 102), and copper-base alloys (CDA 613 and CDA 715). Possible degradation modes affecting these container materials are identified in the context of anticipated environmental conditions at the repository site. Low-temperature oxidation is the dominant degradation mode over most of the time period of concern (minimum of 300 yr to a maximum of 1000 yr after repository closure), but various forms of aqueous corrosion will occur when water infiltrates into the near-package environment. The results of three years of experimental work in different repository-relevant environments are presented. Much of the work was performed in water taken from Well J-13, located near the repository, and some of the experiments included gamma irradiation of the water or vapor environment. The influence of metallurgical effects on the corrosion and oxidation resistance of the material is reviewed; these effects result from container fabrication, welding, and long-term aging at moderately elevated temperatures in the repository. The report indicates the need for mechanisms to understand the physical/chemical reactions that determine the nature and rate of the different degradation modes, and the subsequent need for models based on these mechanisms for projecting the long-term performance of the container from comparatively short-term laboratory data. 91 refs., 17 figs., 16 tabs.

17834 **(UCID—21205) Testing and correction of underground tanks at LLNL: Workplan and schedule.** Henry, R.K.; Schwartz, W.W.; Castro, D.J. (Lawrence Livermore National Lab., CA (USA)). 1 Nov 1987. Contract W-7405-ENG-48. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003876/JAW.

This report defines a workplan and time schedule for leak tightness testing of underground tank systems and for corrective

measures for systems shown by testing to leak. The systems addressed by this report failed a leak tightness test or the test results were inconclusive. The workplan prescribes testing all systems to yield conclusive results. Systems shown to leak will be repaired, retested, and either left in service or be closed. Materials effected by leakage will be cleaned up or removed. 2 figs., 2 tabs.

17835 **(UCRL—96703) Geochemical simulation of dissolution of West Valley and DWPF [Defense Waste Product Facility] glasses in J-13 water at 90°C.** Bruton, C.J. (Lawrence Livermore National Lab., CA (USA)). Nov 1987. Contract W-7405-ENG-48. 14p. (CONF-871124—67). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005619/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Dissolution of West Valley and Defense Waste Product Facility (DWPF) glasses in J-13 water at 90°C at the candidate Yucca Mountain, Nevada repository was simulated using the EQ3/6 computer code package. The objectives of the study were to attempt to predict the concentrations of radionuclides and other glass components in solution resulting from glass dissolution, and to identify potential precipitates that sequester glass components. Modified projected inventories of 10,000 year-old West Valley and DWPF SRL-165 frit glasses were used as starting glass compositions. J-13 water was considered to be representative of groundwater at Yucca Mountain. A total of 10 grams of each glass was assumed to dissolve congruently into a kilogram of J-13 water in a closed system. No inhibitions to precipitation, except for crystalline SiO_2 polymorphs, were assumed to exist. Radiolysis and materials interactions were not considered. Simulation results predict that radionuclides and other glass components precipitate predominantly in the form of oxides and hydroxides, together with carbonates, silicates and phosphates. Precipitates appear to be effective in limiting the concentrations of radionuclides and other elements in solution. The general compositional trends in precipitates and solution chemistry are the same in the West Valley and DWPF simulations, except for variations arising from differences in glass chemistry. 20 refs., 7 figs., 3 tabs.

17836 **Seismic design strategy for surface facilities at the prospective Yucca Mountain nuclear waste repository.** Wu, C.L.; Subramanian, C.V. *Transactions of the American Nuclear Society;* **54**: 66(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

The site of the prospective Yucca Mountain nuclear waste repository is in Nye County, Nevada, ~ 85 miles northwest of Las Vegas. The site is located on federal land that is under the control of the US Dept. of Energy (DOE), the US Air Force, and the Bureau of Land Management. The repository complex will be composed of surface and underground facilities linked by a combination of shafts and ramps. The surface facilities will be built on gently sloping terrain at the eastern base of Yucca Mountain. Seismic considerations pertinent to the design of the surface facilities consist of ground motion generated by both earthquakes and underground nuclear explosions which are conducted periodically in the nearby Nevada test site by DOE. In addition, because of the presence of a number of potentially active faults in the vicinity of the surface facilities site, it may be prudent to design the waste-handling buildings to accommodate minor fault displacement. These design features may be necessary to ensure the radiological safety of the public.

17837 **Engineered sorbent barriers for improved low-level waste disposal.** Mitchell, S.J.; Freeman, H.D. (Pacific Northwest Labs., Richland, WA). *Transactions of the American Nuclear Society;* **54**: 75-76(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

The Engineered Sorbent Barriers Program at Pacific Northwest Lab., supported by the US Dept. of Energy's Low-Level Waste (LLW) Management Program, is developing sorbent materials to prevent the migration of radionuclides from LLW sites. Unlike impermeable barriers, sorbent barriers allow moisture to pass while selectively sorbing contaminants. This would prevent filling the waste site with water at humid sites, referred to as the bathtub effect. The sorptive behavior of these barriers is similar to the ion-exchange properties that many soils possess for certain radionuclides. However, the degree of sorption of radionuclides is dependent on the type of soil, the specific radionuclide, and the presence of competing ions and organic complexants. Therefore, the use of sorptive additives as radionuclide barriers is recommended to prevent radionuclide migration from the waste site. The experimental work discussed in this paper was directed toward identifying and evaluating sorbent materials for three radionuclides of major concern in defense LLW: ^{137}Cs, ^{60}Co, and ^{90}Sr. No single material was found to be effective for sorbing all three radionuclides of interest. Therefore, formulations were developed containing A-51 zeolite or clinoptilolite for sorbing strontium, greensand or red pottery clay for sorbing cesium, and activated charcoal for sorbing cobalt.

17838 **Geotechnical characteristics of fine-grained turbidite sequences from the Nares Abyssal Plain.** Shephard, L.E.; Rutledge, A.K.; Bryant, W.R.; Moran, K.M. (Sandia National Labs., Albuquerque, NM). pp 131-146 of Geology and geochemistry of abyssal plains. Weaver, P.P.E.; Thomson, J. (eds.). Oxford, England; Blackwell Scientific Publications (1987).

Geotechnical property analyses of 21 piston cores obtained from the Nares Abyssal Plain show variations that correspond to facies changes within fine-grained turbidite sequences. Variations in index properties within the turbidite sequences are gradational from the turbidite bases, often containing silt beds or laminae, upwards through the chemically laminated turbiditic clays and into the overlying pelagic and hemipelagic clays. Variations in index properties between sequences can be substantial, with water contents varying by more than 70% over sub-bottom depths of less than a few centimeters. Consolidation test results indicate that most sediments appear to be normally consolidated to over-consolidated. The state of consolidation may vary over short depth intervals within turbidite sequences as a result of the pronounced changes in lithological type. Clay-fabric analyses show significant differences in particle type and degree of sorting between the turbiditic and non-turbiditic clay facies. Particle-to-particle orientations appear quite variable within both clay facies, possibly as a result of modification of the primary fabric by post-depositional changes. 27 references, 16 figures, 1 table.

17839 **Solid State Track Recorder neutron dosimetry in a simulated basalt geological waste repository.** Ruddy, F.H.; Roberts, J.H.; Lippincott, E.P. (Westinghouse Hanford Co., Richland, WA, USA). *Nuclear Tracks and Radiation Measurements;* **11**: No. 4-5, 183-187(1986).

Solid State Track Recorder (SSTR) techniques have been developed for neutron dosimetry applications related to geological storage of radioactive waste. The neutron irradiation environment of spent fuel stored in a simulated basalt geological waste repository was investigated using SSTR neutron dosimetry capsules which contained low mass deposits of fissionable isotopes in contact with mica SSTRs. After exposure for a period of years, the capsules were recovered and the mica SSTRs were retrieved and analyzed. The measured fission rates and derived neutron energy and fluence information are reported.

17840 **Department of Energy mission plan for the civilian radioactive waste management program.** Shaw, G.H. Minneapolis, MN; Univ. of Minnesota ([1988]). vp.

Volume I is the Mission Plan itself, Volume II is a 700+-page collection of public comments on the Draft Mission Plan, and Volume III contains DOE responses to the public comments. Taken as a whole, the document illustrates the development of an agency approach to solving a problem, and the extent to which public input may or may not influence that approach. The Mission Plan itself is DOE's clear statement of how it proposes to go about selecting a permanent site for the disposal of high-level nuclear waste: spent fuel from civilian nuclear power plants and high-level waste produced in reprocessing both civilian and military nuclear materials. Since this program is focused upon site selection based to a large extent upon geologic factors important in inhibiting the release of radionuclides for a long interval of time, it is of consider-

able interest to see how DOE has organized the necessary geologic investigations, and to what extent it proposes to concentrate on the geologic aspects. A key element in the high-level waste disposal program is public confidence in the process. If the public perceives that DOE is continuing investigations at one or more sites when substantial evidence shows that the site(s) are not geologically favorable, then public confidence in the program will disappear. It remains to be seen whether this Mission Plan will be considered the planning document for a successful, carefully organized program of geological input to public policy or merely an element in a record of bureaucratic failure.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 17741, 17750, 17774, 17779, 17783, 17792, 17794, 17800, 17801, 17802, 17804, 17805, 17806, 17807, 17808, 17811, 17813, 17816, 17817, 17832, 17833, 17834, 17835, 17843, 17845, 17870, 19286, 19290, 19291, 19342, 19344, 19345, 19618, 19627, 20344, 20345

0540 Health And Safety

REFER ALSO TO CITATION(S) 17774, 17780

17841 **(BARC—1321) Report on R and D activities of Health Physics Division 1984 - 1985.** Chakraborty, P.P.; Iyer, M.R.; Somasundaram, S. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 200p. NTIS (US Sales Only), PC A09/MF A01. Order Number DE87703138/JAW.

A summary of the research and development programmes undertaken in the Health Physics Division during the period 1984-1985 is contained in the report. The details of the various investigations are given in references listed under each abstract, most of which are published in the form of papers in symposia and journals or as BARC reports. Some of the investigations were carried out in collaboration with other Divisions of BARC and outside organizations. A list of these leading to M.Sc./Ph.D Degrees submitted by members of the Division is given at the end. The Division has also a number of research contracts with IAEA. A summary of work carried out under these projects is included in a separate section.

17842 **(CEA-CONF—9145) Ventilation and clearing of smoke in case of fire in nuclear facilities.** Savornin, J.; Teissier, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Jan 1987. 16p. (In French). (CEA-DAS—319; CONF-8612122—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751865/JAW.

From Meeting on methods and perspectives of fire safety engineering; Paris, France (9 Dec 1986).

Consequences of fires in a nuclear facility can be very serious either by producing smokes or by destruction of shields and contamination. The ventilation is the most sensitive point. In this report dearness is put on part that the ventilation system can play in case of fire beginning either in a nuclear zone or in a non-nuclear zone. References are made on experimental tests.

17843 **(DOE/ID/12584—14) The use of atomic absorption spectroscopy to measure arsenic, selenium, molybdenum, and vanadium in water and soil samples from uranium mill tailings sites.** Hollenbach, M.H. (UNC Geotech, Grand Junction, CO (USA)). Jan 1988. Contract AC07-86ID12584. 45p. (UNC/GJ—38(TMC)). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006148/JAW.

The Technical Measurements Center (TMC) was established to support the environmental measurement needs of the various DOE remedial action programs. A laboratory intercomparison study conducted by the TMC, using soil and water samples from sites contaminated by uranium mill tailings, indicated large discrepancies in analytical results reported by participating laboratories for arsenic, selenium, molybdenum, and vanadium. The present study was undertaken to investigate the most commonly used analytical techniques for measuring these four elements, ascertain routine and reliable quantification, and assess problems and successes of analysts. Based on a survey of the technical literature, the analytical technique of atomic absorption spectroscopy was selected for detailed study. The application of flame atomic absorption, graphite furnace atomic absorption, and hydride generation atomic absorption to the analysis of tailings-contaminated samples is discussed. Additionally, laboratory sample preparation methods for atomic absorption spectroscopy are presented. The conclusion of this report is that atomic absorption can be used effectively for the determination of arsenic, selenium, molybdenum, and vanadium in water and soil samples if the analyst understands the measurement process and is aware of potential problems. The problem of accurate quantification of arsenic, selenium, molybdenum, and vanadium in water and soil contaminated by waste products from uranium milling operations affects all DOE remedial action programs [Surplus Facilities Management Program (SFMP), Formerly Utilized Site Remedial Action Program (FUSRAP), and Uranium Mill Tailings Remedial Action Program (UMTRAP)], since all include sites where uranium was processed. 96 refs., 9 figs.

17844 (IA—1427, pp 30-32) **Effectiveness of protective measures in reducing radiological effect due to an accident in a nuclear power plant.** Koch, J.; Tadmor, J. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

17845 **(ORNL/TM—10244) ORNL Remedial Action Program strategy (FY 1987-FY 1992).** Trabalka, J.R.; Myrick, T.E. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88006152/JAW.

Over 40 years of Oak Ridge National Laboratory (ORNL) operations have produced a diverse legacy of contaminated inactive facilities, research areas, and waste disposal areas that are potential candidates for remedial action. The ORNL Remedial Action Program (RAP) represents a comprehensive effort to meet new regulatory requirements and ensure adequate protection of on-site workers, the public, and the environment by providing appropriate corrective measures at over 130 sites contaminated historically with radioactive, hazardous chemical, or mixed wastes. A structured path of program planning, site characterization, alternatives assessment, technology development, engineering design, continued site maintenance and surveillance, interim corrective action, and eventual site closure or decommissioning is required to meet these objectives. This report documents the development of the Remedial Action Program, through its preliminary characterization, regulatory interface, and strategy development activities. It provides recommendations for a comprehensive, long-term strategy consistent with existing technical, institutional, and regulatory information, along with a six-year plan for achieving its initial objectives. 53 refs., 8 figs., 12 tabs.

0550 Safeguards, Inspection, And Accountability

REFER ALSO TO CITATION(S) 17744, 17767

17846 **Remote visual inspection of nuclear fuel pellets with fiber optics and video image processing.** Moore, F.W. (Hanford Engineering Development Lab., Westinghouse Hanford Co., P.O. Box 1970, Richland, WA). pp 154-160 of International conference on automatic inspection and measurement. Brook, R.A.; Chen, M.J.W. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-850887—).

From SPIE international technical symposium on optical and electro-optical engineers; San Diego, CA, USA (18 Aug 1985).

Westinghouse Hanford Company has designed and is constructing a nuclear fuel fabrication process line for the Department of Energy. This process line includes a pellet surface inspection system that remotely inspects the cylindrical surface of nuclear fuel pellets for surface spots, flaws, or discoloration. The pellets are inspected on a 100 percent basis after pellet sintering. A feeder will deliver the pellets directly to a fiber optic inspection head. The inspection head will view one pellet surface at a time. The surface image of the pellet will be imaged to a closed-circuit color televi-

sion camera (CCTV). The output signal of the CCTV will be input to a digital imaging processor that stores approximately 25 pellet images at a time. A human operator will visually examine the images of the pellet surfaces on a high resolution monitor and accept or reject the pellets based on visual standards. The operator will use a digitizing tablet to record the location of rejected pellets, which will then be automatically removed from the product stream. The system is expandable to automated disposition of the pellet surface image.

17847 **(DOE/DP—0045/1) Semiannual report on strategic special nuclear material inventory differences.** (USDOE Assistant Secretary for Defense Programs, Washington, DC. Office of Safeguards and Security). Jan 1988. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005782/JAW.

This twenty-first periodic semiannual report of unclassified Inventory Differences (ID's) covers the first six months of fiscal year 1987 (October 1, 1986 through March 31, 1987) for all key Department of Energy (DOE) and DOE contractor operated facilities possessing strategic special nuclear materials. Data for the Rocky Flats and Y-12 nuclear weapons production facilities are not included in the report in order to protect classified nuclear weapons information; however, classified ID data from these facilities receive the same scrutiny and analyses as the unclassified data. An inventory difference is the difference between the quantity of nuclear material that a facility's accounting records show to be on hand and that which the facility's physical inventory determines is on hand. Based on extensive review of the factors normally contributing to inventory differences, DOE has established nine categories for accounting purposes. These nine categories are: redetermination of discrete items on inventory, redetermination of material in process, process holdup differences, equipment holdup differences, measurement adjustments, rounding, recording and reporting errors, shipper-receiver adjustments, and identifiable item adjustments.

17848 **(LA-UR—87-4275) Evaluation of the neutron self-interrogation approach for assay of plutonium in high-α,n materials.** Russo, P.A.; Menlove, H.O.; Fife, K.W.; West, M.H.; Miller, B.L. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 13p. (CONF-871110—19). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004297/JAW.

From 3. international conference on facility operations safeguards interface; San Diego, CA, USA (29 Nov 1987).

Neutron self-interrogation is a proposed method for assay of plutonium in bulk materials with very high α,n activity. The simple assay approach assumes that neutron multiplication for the calibration standards is the same as that for the bulk items. Efforts to use bulk properties to determine corrections to the calibration for changing multiplication have been initiated. Self-interrogation assays of bulk pyrochemical residues have been performed. Comparison with tag values obtained by difference gives poor agreement. Comparison with tag values obtained by dissolution and destructive analysis gives agreement at the 10% (1σ) level with no corrections for changing package dimensions or matrix amounts. The agreement improves by a factor of 2 or more if a bulk correction factor (derived from a packaging/matrix study with standards) is applied.

17849 **(LA-UR—88-55) Notes on the MUF-D statistic.** Picard, R.R. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 11p. (CONF-871110—23). NTIS, PC A03. Order Number DE88005374/JAW.

From 3. international conference on facility operations safeguards interface; San Diego, CA, USA (29 Nov 1987).

Many aspects of the MUF-D statistic, used for verification of accountability data, have been examined in the safeguards literature. In this paper, basic MUF-D results are extended to more general environments than are usually considered. These environments include arbitrary measurement error structures, various sampling regimes that could be imposed by the inspectorate, and the attributes/variables framework.

17850 **(LA-UR—88-78) Allocation of inspection resources for international safeguards.** Markin, J.T. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-871110—22). NTIS, PC A02. Order Number DE88005375/JAW.

From 3. international conference on facility operations safeguards interface; San Diego, CA, USA (29 Nov 1987).

Increasing numbers and complexity of facilities inspected by the International Atomic Energy Agency will require difficult decisions about the levels of safeguards to be assigned to materials and facilities should limitations on inspection resources continue. This paper examines some alternative strategies for assigning inspection effort that could improve effectiveness and efficiency of safeguards compared with current inspection practice. These allocation concepts are: (1) extension of inspection planning to include material strata and accounting areas that encompass multiple facilities and (2) the use of randomization of the quality and frequency of inspections and inspection activities.

17851 **(LA-UR—88-79) Integrated safeguards and facility design and operations.** Tape, J.W.; Coulter, C.A.; Markin, J.T.; Thomas, K.E. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 8p. (CONF-871110—24). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005376/JAW.

From 3. international conference on facility operations safeguards interface; San Diego, CA, USA (29 Nov 1987).

The integration of safeguards functions to deter or detect unauthorized actions by insiders requires careful communication and management of safeguards-relevant information on a timely basis. The separation of safeguards functions into physical protection, materials control, and materials accounting often inhibits important information flows. Redefining the major safeguards functions as authorization, enforcement, and verification and careful attention to management of information can result in effective safeguards integration. Whether designing new systems or analyzing existing ones, understanding the interface between facility operations and safeguards is critical to cost-effective integrated safeguards systems that meet modern standards of performance.

17852 **(LA-UR—88-94) Special nuclear material inventory sampling plans.** Vaccaro, H.S.; Goldman, A.S. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-871110—25). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005377/JAW.

From 3. international conference on facility operations safeguards interface; San Diego, CA, USA (29 Nov 1987).

This paper presents improved procedures for obtaining statistically valid sampling plans for nuclear facilities. The double sampling concept and methods for developing optimal double sampling plans are described. An algorithm is described that is satisfactory for finding optimal double sampling plans and choosing appropriate detection and false alarm probabilities. (ACR)

17853 **(LA-UR—88-99) Continuous measurement of uranium concentrations with the laser spark.** Gutmacher, R.G.; Cremers, D.A.; Wachter, J.R. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 4p. (CONF-871110—21). NTIS, PC A02. Order Number DE88005379/JAW.

From 3. international conference on facility operations safeguards interface; San Diego, CA, USA (29 Nov 1987).

Laser-induced breakdown spectroscopy has been applied to the continuous determination of uranium concentrations between 0.1 and 300 g/L in flowing solutions. The technique is rapid, noninvasive, and unaffected by radioactivity. A concentration of 10 g/L was measured with 0.8% precision in 3 min. Substances that absorb at the laser wavelength, suspended materials, and variations in the acidity of the solution have little or no effect on the results. High concentrations of zirconium, cadmium, aluminum, or stainless steel in solution do not interfere.

17854 **(RFP—3960) A measurement control program for plutonium isotopic gamma-ray systems at the Rocky Flats Plant.** Fleissner, J.G. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1986. Contract AC04-76DP03533. 35p. (CONF-860654—50). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005150/JAW.

From 27. annual meeting of the Institute of Nuclear Materials Management; New Orleans, LA, USA (22 Jun 1986).

A sound measurement control (MC) program should be an integral part of every nondestructive assay measurement system used for the assay of special nuclear materials. This paper will describe a measurement control program for plutonium isotopic composition measurements, using high-resolution gamma-ray spectroscopy, that has been implemented in the analytical Laboratories and the Chemistry Standards Laboratory at the Rocky Flats Plant. This MC program emphasizes the standardization of data collection procedures along with the implementation of internal and external measurement control checks to provide the requisite measurement quality assurance. Utilization of these MC checks has been made transparent to the user by software imbedded in the isotopic analysis code GRPAUT. This MC software provides a real time MC response through a hardcopy printout with each isotopic analysis that advises the user as to whether that measurement was in control or note. Data for MC checks to assess long term performance are provided through the use of measurement control history files that are also maintained on each measurement system by the isotopic analysis software. Approximately 1500 to 2000 analyses per month are tracked by this plutonium isotopic measurement control system.

17855 **(RFP—4018) Remote video surveillance and transmission systems.** Senger, S.V. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1986. Contract AC04-76DP03533. 13p. (CONF-8608211—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005139/JAW.

From Armed Forces Communication Electronics Association; Philadelphia, PA, USA (13 Aug 1986).

The need for remote video surveillance is described, and why this capability is essential at the Rocky Flats Nuclear Wespons Plant. Methods of remote surveillance and video buffer zone patrol are examined, as are remote signal transmission techniques and transmission link design considerations. Also discussed are design concepts for a video surveillance viewing center within a security operations area, and the integration of the surveillance video into a computer based alarm system.

17856 **(IAEA-INFCIRC—342) Text of the Agreement of 30 September 1986 concerning the Agency's assistance to Thailand for the transfer of enriched uranium from the United States for a research reactor.** (International Atomic Energy Agency, Vienna (Austria)). Mar 1987. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702730/JAW.

The document reproduces the text of the Project and Supply Agreement concluded on 30 September 1986 between the Agency and the Government of the Kingdom of Thailand and the United States of America for the transfer of enriched uranium (approximately 49.0 kilograms of uranium enriched to approximately 19.90 per cent by weight in the isotope uranium-235) for a research reactor (TRIGA Mark III) in Thailand. 1 table.

0560 Legislation And Regulations

REFER ALSO TO CITATION(S) 17840, 18204, 20743

17857 **(INIS-XN—83) Decree No. 86-1289 of 19 December 1986 amending Decree No. 77-1133 of 21 September 1977 made in implementation of Act No. 76-663 of 19 July 1976 on installations classified for purposes of environmental protection.** (International Atomic Energy Agency, Vienna (Austria)). 23 Dec 1986. 2p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701318/JAW.

Published in Journal Officiel de la Republique Francaise.

This Decree amends certain provisions of the 1977 Decree which concern installations subject to licensing to further refine the licensing procedure. The Decree, on the other hand, does not amend the provisions on the procedure for installations subject to declaration. It also increases the fines for operating installations contrary to the regulations (NEA).

17858 **(INIS-XN—84) Decree No. 77-1133 of 21 September 1977 made in implementation of Act No. 76-663 of 19 July 1976 on installations classified for purposes of environmental protection.** (International Atomic Energy Agency, Vienna (Austria)). 8 Oct 1977. 8p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701319/JAW.

Published in Journal Officiel de la Republique francaise.

This Decree, amended in 1980 and 1985 implements the 1976 Act and contains provisions applying specifically to installations subject to licensing and others which apply solely to installations subject to declaration; also, certain provisions apply to all classified installations. As regards installations subject to licensing, the Decree details the licensing procedure: information to be contained in the application, accompanying documents, conditions of the hearing for issuance of the licensing decree, etc. In addition, it specifies for installations subject to declaration, the particulars to be contained in the declaration, the accompanying documents, the conditions for publicising it as well as the conditions for modifying the general specifications applicable to the installation declared. The provisions of the Decree common to both types of installation mainly concern inspections, conditions to be observed if there is a change in the operator or cessation of activities, and fines in case of non-compliance with the Decree (NEA).

17859 **(INIS-XN—87) Royal Order of 11 February 1987 amending the Royal Order of 28 February 1987 laying down General Regulations concerning Protection of the Public and Workers against the Hazards of Ionizing Radiation.** (International Atomic Energy Agency, Vienna (Austria)). 12 Mar 1987. 2p. (In French, Dutch). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701322/JAW.

Published in Moniteur belge.

This Order implements European Community legislation on radiation protection. It refers to the 1980 Community Directive (as amended in 1984) and concerns standards for liquid or gaseous radioactive effluent releases to the environment. (NEA).

17860 **(INIS-XN—89) 1984 Ordinance on definitions and licences in the atomic energy field. Amendment of 2 March 1987.** (International Atomic Energy Agency, Vienna (Austria)). 2 Mar 1987. 2p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701324/JAW.

Following the partial revision of the Federal Act of 23rd December 1959 on atomic energy concerning import and export of nuclear items and technology the Ordinance of 18th January 1984 on definitions and licensing in the atomic energy field was also amended. The mandatory licensing system now covers the export of technologies (unpublished technical data concerning installations for the enrichment and reprocessing of nuclear fuels as well as for heavy water production). This amendment became effective on 1st April 1987. (NEA).

17861 **(INIS-XN—90) Federal Act on the peaceful uses of atomic energy and protection against radiation. Amendment of 9 October 1986.** (International Atomic Energy Agency, Vienna (Austria)). 9 Oct 1986. 2p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701325/JAW.

The Federal Act of 23 December 1959 on atomic energy was amended to provide a legal basis for controlling exports of nuclear technology (eg unpublished technical data on uranium enrichment, nuclear fuel reprocessing etc). The Federal Council is now empowered to conclude bilateral agreements on imports and exports of nuclear articles. Finally non-proliferation will be expressly mentioned among the licensing criteria for such transactions. This amendment became effective on 1 April 1987. (NEA).

17862 **(INIS-XN—92) Order of 12 June 1986 on protection and control of spent fuel and Category III nuclear material carried by rail.** (International Atomic Energy Agency, Vienna (Austria)). 6 Jul 1986. 2p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701327/JAW.

Published in Journal Officiel de la Republique Francaise.

This Order specifically regulates the transport of Category III spent fuel and nuclear materials within the meaning of the Decree of 12th May 1981 and supplements the regulations already in force applicable to transport of dangerous goods, including nuclear materials. The Order details the conditions to be complied with by the carrier, whether foreign or French, holder of a licence in accordance with the Act of 25th July 1980 on protection and control of nuclear materials. (NEA).

17863 **(INIS-XN—94) Order of 5 November 1986 on transport of hazardous materials (hazardous materials 1986, No. 11).** (International Atomic Energy Agency, Vienna (Austria)). 21 Dec 1986. 4p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701329/JAW.

Published in Journal Officiel de la Republique francaise.

This Order concerns the transport of hazardous materials including radioactive materials. The Annex to the Order amends and supplements the Regulations of 15th April 1945 on the transport of dangerous goods. In particular, it is provided that specific measures to implement the Regulations on transport can now be adopted by Ministerial Instruction concerning defence-related hazardous materials and nuclear materials in Categories I and II (with the exception of spent fuel) as defined in the Table annexed to the Decree of 12th May 1981 on protection and control of nuclear materials. (NEA).

17864 **(INIS-XN—98) Code of Practice on radiation protection in the mining and milling of radioactive ores (1980) - Guidelines for storage and packaging of uranium concentrates.** (Department of Arts, Heritage and Environment, Canberra (Australia)). 1986. 17p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701481/JAW.

This Guideline is intended to provide assistance in the application of the 1980 Code of Practice on radiation protection in mining and milling of radioactive ores. Its purpose is to give advice relevant to the design, construction and operation of an uranium concentrate storage and packaging facility in which exposure to ionizing radiation from uranium-bearing concentrate will not only conform to the Code, but will also be as low as reasonably achievable. (NEA).

17865 **(INIS-XN—99) Environment Protection (Sea Dumping) Amendment Act 1986 - No. 141 of 1986.** (International Atomic Energy Agency, Vienna (Austria)). 9 Dec 1986. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701333/JAW.

The Act of 1981 provides for protection of the environment by regulating the dumping into the sea (and incineration at sea) of wastes and other matter. The main purpose of the amendments of the 1986 Act which entered into force on 6 January 1987 is to prohibit the dumping of radioactive material into the sea. (NEA).

17866 **(INIS-XN—101) Nuclear Non-proliferation (Safeguards) Act 1987 - No. 8 of 1987.** (International Atomic Energy Agency, Vienna (Austria)). 17 Mar 1987. 89p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88701335/JAW.

This Act aims at giving domestic legislative effect to Australia's international non-proliferation obligations and establishes controls over the possession and transport of nuclear materials and equipment by a system of permits. These obligations arise inter alia under the NPT Convention on the Physical Protection of Nuclear Material. The Act provides that its provisions shall apply to nuclear material (as defined in Article XX of the IAEA Statute) and associated items which include associated material, equipment or technology. These are clearly defined in the Act. (NEA).

17867 **(INIS-XN—102) Nuclear Non-Proliferation (Safeguards) Regulations - Statutory Rules 1987 No. 75.** (International Atomic Energy Agency, Vienna (Austria)). 7 May 1987. 3p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701336/JAW.

These Regulations were made in furtherance of the Nuclear Non-Proliferation (Safeguards) Act 1987 and prescribe conditions in relation to permits and authorizations for nuclear material. The Regulations specify the nuclear material which is exempted from control under the Act. Such exemption covers in particular, nuclear material exempted from safeguards by the IAEA. Also, they set out the particulars to be given in notices to be published in the Commonwealth Gazette when the Minister for Resources and Energy will grant, vary or revoke a permit or authorization under the Act. (NEA).

17868 **(INIS-XN—103) Customs Tariff (Uranium Concentrate Export Duty) Act 1980 - No. 16 of 1980.** (International Atomic Energy Agency, Vienna (Austria)). 16 Apr 1980. 2p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701337/JAW.

This Act fixes the rate of the Customs duty on uranium concentrates exported from the Alligator Rivers Region. (NEA).

17869 **(INIS-XN—104) Customs Tariff (Uranium Concentrate Export Duty) Amendment Act 1987 - No. 57 of 1987.** (International Atomic Energy Agency, Vienna (Austria)). 5 Jun 1987. 2p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701338/JAW.

This Act raises the customs duty for exporting uranium concentrates from the Alligator Rivers Region, fixed by the Customs Tariff (Uranium Concentrate Export Duty) Act 1980. (NEA).

17870 **(INIS-XN—105) Environment Protection (Alligator Rivers Region) Amendment Act 1987 - No. 17 of 1987.** (International Atomic Energy Agency, Vienna (Austria)). 18 May 1987. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701339/JAW.

This Act amends the Environment Protection (Alligator Rivers Region) Act 1978. The amendments mainly concern definition of general mining operations and specification of the functions of the Supervisory Scientist and the Research Institute in relation to general mining in an environment conservation zone (parts of the Alligator Rivers Region). The 1978 Act provided for the appointment of a Supervising Scientist responsible for supervising protection of the environment against the effects of uranium mining in the Region, and for the creation of a Research Institute under his management. (NEA).

17871 **(INIS-XN—119) Act to Control and Regulate the Possession, Sale, Transport and Use of Radioactive Substances and the Possession and Use of Certain Apparatus capable of producing Radiation.** (International Atomic Energy Agency, Vienna (Austria)). 7 May 1958. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701341/JAW.

This Act covers all activities involving radioactive materials and radiation sources. It sets up a Radiological Advisory Council to advise the Minister responsible for health in Queensland on administration of the Act, regulations made thereunder and on preventing and minimising dangers arising from radioactive materials and radiation sources. It lays down the Council's composition and rules of procedure. The Act also provides for the licensing, control and registration of such materials and sources, including sanctions in case of non-compliance with its provisions. (NEA).

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

17872 **(DOE/ET/33006—011) Plasma separation process: Quarterly technical report for period 1 October 1987 through 31 December 1987.** (TRW Space and Technology Group, Redondo Beach, CA (USA)). 1988. Contract AC03-77ET33006. 78p. NTIS, PC A05. Order Number DE88004031/JAW.

The closeout plan was modified during the quarter to reflect a no cost extension of the Phase II period of performance from 15 November 1987 through 15 January 1988 and a delay of the PPM magnet warmup to the first quarter of CY 1988. The magnet warmup delay was instituted to allow the possible use of the PPM for an application demonstration. To maintain the overall closeout schedule, the resources associated with the magnet warmup are being used to accelerate the PPM process hardware decontamination. 8 figs., 4 tabs.

17873 **(ORNL/TM—10641) Gadolinium-153 production at the Oak Ridge National Laboratory.** Ramey, D.W. (Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006053/JAW.

Gadolinium-153 production at ORNL involves the neutron irradiation of natural europium oxide (47.8% ^{151}Eu, 52.2% ^{153}Eu). This target material undergoes a series of neutron captures and radioactive decays to produce the desired ^{153}Gd product. Several undesirable europium isotopes (^{152}Eu, ^{154}Eu, and ^{156}Eu) are also produced during this irradiation process. Recent technical advances and other improvements in the radiochemical processing of this isotope have allowed ORNL to increase production by more than sevenfold. A newly developed electrochemical process separates the bulk of undesirable europium isotopes. The use of this process increases the efficiency of the high-pressure ion exchange step and effects a final product purity of >99.999%. Specific activities >60 Ci/g of gadolinium oxide and product specific yields >2.9 Ci/g of irradiated europium oxide have been produced. Use of unique glove box manipulators and special equipment designed at ORNL have allowed final source fabrication to keep pace with the increased production rate while minimizing the radiation exposure to operating personnel. 3 figs., 4 tabs.

17874 **Application of atomic vapor laser isotope separation to the enrichment of mercury.** Crane, J.K.; Erbert, G.V.; Paisner, J.A.; Chen, H.L.; Chiba, Z.; Beeler, R.G.; Combs, R.; Mostek, S.D. (Lawrence Livermore National Lab., CA, USA). pp 251-254 of Resonance ionization spectroscopy 1986. Proceedings of the third international symposium on resonance ionization spectroscopy and its applications held at the University College of Swansea, Wales, on 7-12 September 1986. Hurst, G.S.; Morgan, C.G. (eds.). Bristol, England; Institute of Physics (1986). (CONF-8609132—).

From Resonance ionization spectroscopy and its application; Swansea, UK (7 Sep 1986).

Price Pound 35.00.

The authors discuss the results of recent work carried out at Lawrence Livermore National Laboratory to develop a process for enriching mercury. The discussion centers around the results of spectroscopic measurements of excited-state lifetimes, photoionization cross sections, and isotope shifts.

17875 **Nuclear isomer separation.** Dyer, P. (Los Alamos National Lab., NM, USA). pp 257-262 of Resonance ionization spectroscopy 1986. Proceedings of the third international symposium on resonance ionization spectroscopy and its applications held at the University College of Swansea, Wales, on 7-12 September 1986. Hurst, G.S.; Morgan, C.G. (eds.). Bristol, England; Institute of Physics (1986). (CONF-8609132—).

From Resonance ionization spectroscopy and its application; Swansea, UK (7 Sep 1986).

Price Pound 35.00.

Pure specimens of nuclear isomers are required for gamma-ray lasers. The author has selectively photoionized atoms containing isomeric nuclei of /sup 197/Hg. The isomers were produced by the /sup 197/Au(d, 2n)/sup 197/Hg reaction and distilled. Three pulsed dye lasers were used to selectively ionize mercury atoms by double resonant three-step photoionization. Other isomer separation techniques and their limitations are discussed.

17876 **(BARC—1326) Studies on corrosion inhibitors for the cooling-water system at the Heavy Water Project, Kota.** Pillai, B.P.; Mehta, C.T.; Abubacker, K.M. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703140/JAW.

The Heavy Water Project at Kota uses the water from the Rana Pratap Sagar Lake as coolant in the open recirculation system. In order to find suitable corrosion inhibitors for the above system, a series of laboratory experiments on corrosion inhibitors were carried out using the constructional materials of the cooling-water system and a number of proprietary formulations and the results are tabulated. From the data thus generated through various laboratory experiments, the most useful ones have been recommended for application in practice. 35 tables.

17877 (IA—1427, pp 144-145) **Removal of suspended alumina particles from heavy water by electroadsorption on fibrous carbon electrodes.** Tobias, H.; Taragan, E.; Oren, Y.; Soffer, A. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

0702 Radiation Sources

REFER ALSO TO CITATION(S) 19563

17878 **(INCT—2009/3/D/B) Attempt to evaluate some regression models used for radiometric ash determination in the brown coal.** Karamuz, S.; Urbanski, P.; Antoniak, W.; Wagner, D. (Institute of Nuclear Chemistry and Technology, Warsaw (Poland)). 1984. 18p. (In Polish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701311/JAW.

Published in 1985. Received in Dec 1987.

Five different regression models for determination of the ash as well as iron and calcium contents in brown coal using fluorescence and scattering of X-rays have been evaluated. Calculations were done using experimental results obtained from the natural brown coal samples to which appropriate quantities of iron, calcium and silicon oxides were added. The secondary radiation was excited by Pu-238 source and detected by X-ray argone filled proportional counter. The investigation has shown the superiority of the multiparametric models over the radiometric ash determination in the pit-coal applying aluminium filter for the correction of the influence of iron content on the intensity of scattered radiation. Standard error of estimation for the best algorithm is about three time smaler than that for algorithm simulating application of the aluminium filter. Statistical parameters of the considered algorithm were reviewed and discussed.

17879 **(PB—88-130620/XAB) Flaw detection, sizing, and location by Differential Gamma Scattering Spectrum technique. Final report.** Diaz, N.J.; Anghaie, S. (Florida Nuclear Associates, Inc., Gainesville (USA)). Aug 1985. 142p. NTIS, PC A07/MF A01.

The basic scientific feasibility of the Differential Gamma Scattering Spectrum (DGSS) technique for nondestructive detection, sizing, and location of flaws in near-, far-, and mid-surface ranges was investigated. The inverse radiation-transport method and Monte Carlo numerical simulation were used to eliminate the complications of multiple scattering and to predict the effects of the major physical phenomena involved in Compton Profile Densitometry. The experimental program consisted of two related phases. Initially, results of previously obtained measurements, using a low-

energy source and a low-density material, were reanalyzed to determine the applicability, limitations, and preferred geometrical configurations. These analyses provided valuable information for the high-density experimental program.

0703 Isotopic Power Supplies

17880 **(DP-MS—87-130) Weldability of general purpose heat source new-process iridium.** Kanne, W.R. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 5p. (CONF-8710203—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002443/JAW.

From IMOG joining subgroup meeting; Kansas City, MO, USA (13 Oct 1987).

Weldability tests on General Purpose Heat Source (GPHS) iridium capsules showed that a new iridium fabrication process reduced susceptibility to underbead cracking. Seventeen capsules were welded (a total of 255 welds) in four categories and the number of cracks in each weld was measured.

17881 **(LA—11127-MS) High-temperature compatibility study of iridium (DOP-26 alloy) with graphite and plutonia.** Axler, K.M.; Eash, D.T. (Los Alamos National Lab., NM (USA)). Dec 1987. Contract W-7405-ENG-36. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005111/JAW.

This report outlines the materials compatibility tests conducted on DOP-26 iridium alloy and carbon. The carbon used was in the form of woven graphite as present in the impact shell used to encase plutonia in nuclear heat sources. In addition, compatibility tests of the DOP-26 alloy with plutonia are described. The reactivity observed in both systems is discussed. 4 refs., 6 figs.

0704 Economics

17882 **(CBPF-CS—006/87) Some aspects of the development of the Brazilian Synchroton Radiation Project.** Danon, J. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1987. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701417/JAW.

The history and development of the Brazilian Synchroton Radiation Project are presented. Several aspects of this project may serve as a guide to achieve success in North-South cooperation. (M.W.O.).

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 17441, 17442, 17504, 17516, 17520

17883 (DOE/METC—87/6079-Vol.2, pp 509-513) **Novel approach to hydrogen recovery, storage, and transport.** Krascella, N.L. (United Technologies Research Center, East Hartford, CT). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objective of this contract is to demonstrate, on a laboratory scale, the selective recovery of hydrogen from a mixed gas stream typical of coal gasification system, or initial stage fiber membrane separator output via the hydrogenation-dehydrogenation reactant pair. Experimental results obtained in this investigation will provide a data base for preliminary engineering-economic assessment of the organic hydride recovery, storage, and transport system and will serve as a basis for comparison with respect to state-of-the-art recovery, storage, and transport technology. The test plan is described. Experimental work is still in the initial stages, so no results are available. 7 references.

17884 (DOE/METC—87/6079-Vol.2, pp 514-518) **Hydrogen recovery by novel solvent systems.** Shinnar, R. (City Univ. of New York, NY). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objective of this work is to develop a novel method for purification of hydrogen from coal-derived synthesis gas. The study involves the search for suitable mixtures of solvents for their ability to separate the hydrogen from the coal derived gas stream in significant concentration near their critical point of miscibility. The properties of solvent pairs identified will be investigated in more detail to provide data necessary for economic evaluation and process development. Test facilities are now being fabricated. 5 references.

17885 (DOE/METC—87/6079-Vol.2, pp 519-525) **Low cost hydrogen/novel membrane technology for hydrogen separation from synthesis gas.** Baker, R.; Wijmans, H.; Pinnau, I.; Roberts, D. (Membrane Technology and Research, Inc., Menlo Park, CA). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2). Contract AC21-85MC22130.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The separation of hydrogen from synthesis gas is a major cost element in the manufacture of hydrogen from coal. Separation of these gases by membranes is an alternative technique that is still largely unexplored and that could offer substantial cost saving. The objective of this program is to develop membranes suitable for these separations and demonstrate their applicability with small spiral-wound modules on model gas mixtures representative of those found in synthesis gas processes. As an initial step in the program, a review of polymer permeability data, either available in the literature or obtained at MTR, was performed. Based on this initial screening, two polymers were selected for membrane development work: poly(etherimide) for the separation of hydrogen from nitrogen and from carbon monoxide; and poly(ether-ester-amide) for the separation of hydrogen sulfide and carbon dioxide from hydrogen. Results from the fabrication and testing of membranes of these materials are given. A computer model is briefly described which was developed for use in the evaluation of membrane systems.

17886 (NP—8770039, pp 81-94) **Hydrogen from Coal Process Development.** Kikuya, Kiyoshi. 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

Since 1983, a study on a oxygen injection coal gasifier has been carried out by New Energy Development Organization as one tem of Sunshine Project promoted by MITI, bringing about a conclusion that the technology acquired from the study is promising as a process for producing hydrogen from coal at low cost. Then Hydrogen from Coal Process Development (HYCOL) has been organized in 1986 so as to draw up a plan of the research and development by means of a pilot plant. The design and construction of the plant will be made approximately within 5 years, thereafter an operational research will be taken up for 3 years. The plant will be of a scale of 50 t/day coal throughout and composed of, as a core of the technology, an entrained bed type coal gasifier with one chamber two stage rotary flow system, which is considered to be an optimum system. The execution of design, construction and operational research of the plant for 8 years will facilitate the technological development in the gasifier and total plant system thereby realizing an efficient and high reliability plant system.

0802 Storage

REFER ALSO TO CITATION(S) 17883

0803 Transport

REFER ALSO TO CITATION(S) 17883

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 18518

17887 **(DOE/PC/80011—T3) Development and process evaluation of improved Fischer-Tropsch slurry catalysts: Quarterly technical progress report for the period 1 April to 30 June 1987.** Withers, H.P.; Bukur, D.B.; Rosynek, M.P. (Air Products and Chemicals, Inc., Allentown, PA (USA); Texas A and M Univ., College Station (USA)). 25 Aug 1987. Contract AC22-85PC80011. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88003396/JAW.

Three runs were made with a commercial fused iron catalyst with objectives to study the effects of catalyst reduction procedure, particle size and process conditions on fixed bed reactor performance (activity and product selectivity). The catalyst activity increases as the space velocity of H_2 during the reduction increases or as the catalyst particle size decreases. An uncalcined precipitated iron catalyst (100 Fe/1 Cu/0.2 K on weight basis) was evaluated in a fixed bed reactor. Initially, it showed an activity more than twice of the fused iron catalyst, but it deactivated after about 30 hours on stream. The work on catalyst synthesis and characterization of the precipitated iron catalysts has continued. 25 precipitated iron catalysts (Fe/Cu, Fe/K and Fe/Cu/K) have been prepared. Temperature programmed reduction has revealed that the iron reduction is facilitated in the presence of copper. Also, unpromoted iron and potassium promoted iron (containing 1 part K per 100 parts Fe) were examined using Fourier Transform Infrared Spectroscopy. 9 refs., 19 figs., 8 tabs.

17888 **(FRNC-R—160) Implementation and utilization of biogas.** Perret, J.P. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1983. 322p. (In French). NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751077/JAW.

A review of the characteristics and problems encountered during production, transportation and utilization of biogas is presented: chemical analysis of the biogas (Instruments), corrosiveness of biogas and its effects on ducts, design of the ducts and duct network, flow rate control, biogas purification (gas-solid process, gas-liquid process, drying, biological process), biogas combustion characteristics and comparison with other gaseous fuels in France, description and design of the different types of biogas burners and motors, security aspects and regulations concerning the digesters, the storage equipments, the duct network and the burners and motors. Industrial applications of biogas are also reviewed.

17889 (DOE/METC—86/6043, pp 121-131) **Biological conversion of coal synthesis gas.** Clausen, E.C.; Gaddy, J.L. (Univ. of Arkansas, Fayetteville). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract AC21-84MC21011.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The overall objective of this two year study was to determine the feasibility of biologically converting coal synthesis gas into methane. Both mixed and pure cultures were examined in stirred tank and fixed film reactors to determine whether methane could be produced from CO, CO_2 and H_2 by these microorganisms and to measure the required retention time. Sulfur toxicity of the organisms was assessed and operation of the cultures at elevated pressures was examined.

17890 **(AD-A—186346/3/XAB) Methane synthesis over transition-metal electrodes in a solid-state ionic cell. Technical report.** Gur, T.M.; Huggins, R.A. (Stanford Univ., CA (USA). Dept. of Materials Science and Engineering). 1986. 6p. (TR—1). NTIS, PC A02/MF A01.

Pub. in Jnl. of Catalysis, Vol. 102, 443-446(1986).

A solid-state electrochemical technique can significantly enhance the rate of hydrogenation of CO over Fe, Ni, and Co catalysts. In-situ control of the oxygen activity at the gas/catalyst interface can cause an enhancement of up to fivefold in the reaction rates at temperatures in the range 535 to 700 C. The work used oxide ion conduction in heavily doped ZrO_2.

17891 **(IFP—34-977) Modification of zeolites. Application to methanol conversion in light olefins.** Ferre, G. (Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison). Sep 1986. 287p. (In French). NTIS (US Sales Only), PC A13. Order Number DE88751075/JAW.

Transformation of methanol into hydrocarbons requires acid catalysts, zeolites are the more important. Acidity should be adjusted by increasing the ratio Si/Al. Modification of zeolites is studied and especially desalumination of offretite, clinoptilolite, ferrierite and erionite. These modification processes are followed by X-ray diffraction, NMR of silicon 29 and aluminium 27, nitrogen and hydrocarbon adsorption, infrared etc. Catalytic conversion of methanol into olefins is studied with modified zeolites and are compared to performance of zeolite Y, zeolite ZSM5 and mordenite. Selectivity and stability of zeolites are evaluated and compared during catalytic test at high conversion (industrial conditions and for some zeolites at low conversion. 241 refs.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 18387

17892 (NP—8770039, pp 497-519) **Research of elements of methanol reformed type power generation.** Nagaya, Kiichi. (Hitachi Zosen Corp., Osaka, Japan). 19 Sep 1986. (in Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

This research is the three year project and this is the annual report of the first year, 1985. The major achievements of the year are as follows; (1) Concerning the research of unevenly porous catalyst, precious metal catalysts and copper catalysts were tested. (2) With regards to evenly porous catalyst, methanol reformed catalysts using natural zeolite were designed and manufactured. Nine promissing catalysts were obtained. (3) With respect to the research of heat-reclamation and reaction, a stationary analytical research was made on three types of combination of reactor and heat reclaimer. Reaction characteristics of Cu-Zn, Zn-Cr and K catalysts were tested with a small testing apparatus. Besides two heat mediums were chozen after heat stability tests of heat mediums. Based upon these results, basic design was made for a bench-scale testing device with capacity equivalent to 100KW at the generating terminal. (4) Concerning research of combustion, reformed methanol was evaluated. In accordance with respective characteristics of steam reformed gas and decomposed gas, basic design was made for a diffusion type burner and a diffusion-premixing combined type burner. Also for combustion tests using various simulated reformed gases, a simulated gas stoker and a control system etc. were planned and designed. (17 figs, 5 tabs)

17893 (NP—8770045, pp 451-462) **Development of fuel alcohol. Screening and breeding of exellent bacteria strains.** Nakamura, Katsumi. (Kirin Brewery Co., Ltd., Tokyo, Japan). 20 Sep 1985. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

In Proceedings of parallel sessions for the 5th NEDO general assembly.

Development of ethanol zymogens for industrial alchohol fermentation with more excellent characteristics than the existing ones has been carried out. Zymomonas bacteria was chosen as the target of this study. The results were as following. 1) A screening

system of Zymomonas bacteria was established. 2) 320 storks of bacteria with similar ethanol productivity with Z.mobilis NRRL B-14023 were acquired. 3) 33 kinds of plasmid as candidates of vectors were made from native plasmid of Zymomonas. 4) Safety of mobiles NRRL B-14023 as a host by a survival test in underground water, city water, sewage water and in a mouse body. 5) Cellulase gene group of Cellulomonas uda, a cellulose-decomposing bacteria, was croned into E, coli. (7 figs, 5 tabs)

17894 (NP—8770045, pp 463-475) **Development of fuel alcohol. Development of attached-bacteria method.** Kamino, Yasumi. (Hitachi Zosen Corp., Osaka, Japan). 20 Sep 1985. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

In Proceedings of parallel sessions for the 5th NEDO general assembly.

Development on attached-bacteria method has been carried out to establish a continuous fermentation process with high yields of fuel alcohol. In 1984, a continuous fermentation of the mixture of attached bacteria and agglutinated yeast (as zymomonas bacteria would be easily polluted by other bacteria in such material as blackstrap molasses) was carried out with a test plant. The test plant was organized to adopt the two-step fermentation method. 0.1Kl/day alcohol production goal was attained by using blackstrap molasses from the Philippines, buttthe molasses from Okinawa indicated the existence of certain inhibiting factors. Pollution by other bacteria might be prevented by a continuous fermentation carried out at high bacteria density in the bath. (3 tabs, 9 figs)

17895 (NP—8770045, pp 476-498) **Development of fuel alcohol. Development of flash fermentation method.** Iida, Kozo. (Kansai Paint Co., Ltd., Amagasaki, Japan). 20 Sep 1985. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

In Proceedings of parallel sessions for the 5th NEDO general assembly.

The establishment of highly efficient alcohol fermentation was intended by combining the technology of condensing yeast and the technology of flash fermentation which improves the speed of alcool production. The outline is shown below. Continuous fermentation tests with small fermentation device; By using a small fermentation device which produces 1 liter of alcohol per day, tests were made and the flashing conditions most suitable for the production activity of alcohol were examined. Selection tests of yeast for flash fermentation; Utilizing yeast at hand, its alcohol production capability under high salt concentration was studied. Study concerning preservation of highly condensed yeast; Conditions of preserving granule highly-condensed yeast and membrane highly-condensed yeast, and alcohol fermentation activity were measured with the lapse of time. Study concerning high condensation of yeast suitable for flash fermentation; In order to find out the possibility of high condensation of bacteria, a study of high condensation with parallel usage of ion resin and granule high condensation was made and cultivation tests with molasses medium etc. were performed. (9 figs, 17 tabs, 2 photos)

17896 (NP—8770046, pp 1048-1054) **Technology development of fuel alcohol.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

(1) Search and breeding of superior bacteria; Group No. 1: 1. Research was made to separate ethanol fermentative bacteria from overseas source of bacteria, and high salt resisting and high temperature fermentable strain, Z. mobilis (like) bacteria was obtained. 2. Cellulose decomposing fermentation gene was introduced to ZYMOMONAS bacteria. Group No. 2: ZYMOMONAS bacteria were separated form bacteria source of Central and South America, and bacteria with high temperature fermentation, high fermentation yield, and high ethanol resisting property were obtained. Group No. 2: Separation and evaluation of bacteria were performed with the result of obtaining strain with high salt and sugar resistivity. (2) Development of adhesive biomass method; With blackstrap molasses, fermentation yield was 70% for 0.1 h^{-1} dilution rate, but about 60% for 0.5 h^{-1}. (3) Development of flash fermentation method; 1. High density biomass was reserved at 5'C for 3 to 4 months, and had no problem for practical use. 2. As the result of a continuous operational study totaling over 2,000 hours on a test plant with 5 kl/d alcohol production capacity, fermentation yield was 80%, and the density of alcohol was 11%.

17897 **(DOE/PC/90013—T3) Optimum catalytic process for alcohol fuels from syngas: Third quarterly technical progress report, July-September 1987.** (Union Carbide Corp., South Charleston, WV (USA). Engineering, Manufacturing and Technology Services Div.). 30 Oct 1987. Contract AC22-86PC90013. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005300/JAW.

Investigations on the novel low-pressure methanol homologation system have continued; in particular, the direct conversion of syngas to alcohols using promoted ruthenium catalysts. Our goal is to improve the behavior of the catalyst so that a product containing a substantial amount of higher alcohols (C/sub 2+/ alcohols) can be produced at low pressures. Earlier, we found that the addition of two specific catalyst additives increased the activity of the ruthenium/I^- catalyst system, and at the same time increased the production of C/sub 2+/ alcohols significantly. We have now found that higher activity can be achieved by using a similar replacement for one of these additives, and by using LiI as the iodide source. This system is relatively active at a pressure of 3000 psi and 230°C, with a rate to products of 4.6 M/h and a selectivity to C/sub 2+/ alcohols of 26%. We have continued work on the heterogeneously catalyzed system based on alkali-loaded molybdenum sulfide and cobalt-molybdenum sulfide catalysts. 7 figs., 10 tabs.

17898 **(SAND—87-2836C) Novel catalysts for methane activation.** Stohl, F.V.; Shelnutt, J.A.; Granoff, B. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 19p. (CONF-871249—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003637/JAW.

From Indirect liquefaction contractors' conference; Pittsburgh, PA, USA (7 Dec 1987).

Several naturally occurring enzymes, such as cytochrome P-450 and methane monooxygenase, catalyze the oxidation of alkanes to alcohols at low temperatures and pressures. We are attempting to develop catalysts that mimic the activity of these enzymes. Computer-aided design studies on unique carboranyl porphyrins have shown that they can have a pocket analogous to those of the enzymes. This work uses molecular-energy dynamics calculations to evaluate the methane interactions with the synthetic compounds. Activity tests have been devised for oxidation of cyclohexane, hexane and butane with iodosylbenzene as the oxidant, methylene chloride as the solvent, and Fe, Mn, Ni, and Rh tetraphenyl porphyrins and Fe and Mn tetra(pentafluorophenyl) porphyrins as catalysts. Results showed that Fe and Mn were the most active metals. With the Fe tetra(pentafluorophenyl) porphyrin, cyclohexanol, hexanol and butanol yields (based on oxidant) were 80%, 64% and 40%, respectively. Additional tests are being developed for oxidation of ethane and methane. 17 refs., 8 figs.

17899 **Methanol synthesis over palladium supported on silica.** Kelly, K.P.; Tatsumi, T.; Uematsu, T.; Driscoll, D.J.; Lunsford, J.H. (Texas A & M Univ., College Station). *Journal of Catalysis;* **101**: No. 2, 396-404(Oct 1986).

Methanol synthesis activity of palladium supported on four types of silica (Davison 01, 03, 57, and 59) were evaluated at 16 atm and 255°C in a Berty-type reactor. Turnover frequencies (TOF) were determined based on hydrogen chemisorption data. The TOF's for a particular type of silica increased with decreasing metal dispersion, but for equivalent dispersions the silicas had a marked effect, with TOF's following the sequence $Pd/SiO_2(59) > Pd/SiO_2(57) > Pd/SiO_2(01,03)$. Preliminary results on unsupported Pd show that the activity was less than expected on the basis of particle size. Thus, the silica promotes the activity of the Pd, even though the supported metal particles are relatively large and the TOF increases with particle size. Chloride ions enhance activity by stabilizing higher dispersions and by increasing TOF's. Lithium ions effect extensive sintering of the silica support and promote activity by increasing the TOF. The latter increase may, in part, be the result of more efficient use of Pd surface which occurs via the exclusion of small pores. The more active Pd/SiO_2 catalysts were found to be comparable in activity to a commercial methanol synthesis catalyst. 14 references.

17900 (NP—8770039, pp 435-447) **Development of fuel alcohol technology. Screening and breeding of excellent bacteria strains.** Yagi, Yoshiro. (Sanraku Incorporated, Tokyo, Japan). 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

This report relates to the study in 1985 for the screening and breeding of the ethanol fermentation bacteria, especially the Zaimomonas strain. Samples came from Japan (Miyazaki, Okinawa) and the South and Central America. Satisfactory bacteria was collected only from the Mexican samples. Two out of the separated bacteria showed excellent ethanol productivity under high temperature, high salt content, and high sugar. Methods of spheroplastization of Z. mobilis and regeneration were established. Cell fusion was successfully made between the mutants with different nutrition requirement of Z. mobilis NRRL. Agrobacterium tumefaciens, one of the two selected strains which were reproducible in the presence of 4% NACl, was possible to be spheroplastized and regenerated in the condition similar to Zaimomonas. (9 figs, 6 tabs)

17901 (NP—8770039, pp 448-468) **Development of fuel alcohol technology. Devlopment of attached-bacteria method.** Nakada, Toshiyuki. (Hitachi Zosen Corp., Osaka, Japan). 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

This is a NEDO buisiness report for 1986. This experiment was carried out in 1986 , wherein the detection and breeding of the excellent bacteria strain were made for the selection of a bacteria applicable to the attached-bacteria method, which led to the construction of a compact, continuous fermentation unit (1 kl/d alcohol production) in the Izumi Alcohol Plant of NEDO. By this unit, the bacterial phases during the continuous fermentation were studied as well as the relation between the fermentation yield and the concentration and dilution of the molasses. In view of the problem of Zaimomonas mobilis being affected by the presence of salt, the molasses were desalinated and checked for the fermentation behavior. The bacteria used in this unit was Z. mobilis HSZM 1006. Two units of fermentation tank were of fluidized bed type, with 23.5 L and 35 L volume. Yield of fermentation was improved by the desalination both for the batch and the continuous processes. In the case of the desalinated molasses (k=3.5 ms/cm), concentration of alcohol formed was 55 g/l, fermentation yield 70%, and alcohol productivity 28 g/L-h. Figures for the non-desalinated molasses were 48, 65, and 24 respectively. (15 figs, 7 tabs)

17902 (NP—8770039, pp 469-488) **Technology development of fuel alcohol. Development of flash fermentation method.** Yamada, Tomiaki. (JGC Corporation, Tokyo, Japan). 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

This is the 1985 report of the four year project starting from 1983. This project has the objective to establish a highly economical fuel alcohol production system by means of 1) improving productivity of alcohol through efficient fermentation of highly concentrated alcohol by application of the combination of continuous fermentation and flash fermentation and 2) reducing construction and operation costs concerning the alcohol separation and refinement process and the drainage treatment process. During 1985, the highly-condensed yeast for flash fermentation was selected for the Izumi test plant and continuous flash fermentation tests were carried out for three periods through the operation of a migdet plant as preceding tests for the operation of the test plant above. Furthermore a granule highly-condensed yeast production apparatus was improved after its trial run and used for yeast production. Concerning the Izumi test plant, 2200 hour level continuous operations were executed twice with and without flash method. Through the above operations, the flash fermentation process was established, engineering data for designing an industrial plant were obtained and technological know-how was accumulated. (10 figs, 5 tabs)

17903 (NP—8770044, pp 479-484) **Development of fuel alcohol technology. Screening and breeding of excellent bacteria strains.** Matsumoto, Shinya. (Suntory Limited, Osaka, Japan). 21 Sep 1984. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

In Proceedings of parallel sessions for the 4th NEDO general assembly.

This is a report for 1983, the first year of the NEDO-contracted project,wherein the knowledge and the result of study are described on the alcohol fermentation mainly by Zaimomonas bacteria. Zaimomonas is an anaerobic gram-negative bacteria, and ATP yield in the alcohol fermentation is 1 mol per 1 mol of glucose (1/2 of yeast). As to a fermentable sugar, there is a limitation that sugar above trisaccharide cannot be fermented. Optimum fermentation temperature is 30 'C, and fermentation and and breeding do not proceed at the initial alcohol concentration above 13.8 V/V%. Higher salt concentration retards the fermentation, but the initial pH of 5 - 6 gives best fermentation ability. Higher glucose concentration reduces the rate of fermentation. Zaimomonas gives much faster alcohol formation with as high alcohol yield as 97 % of the theoretical value. Zaimo-monas has not been separated from the microorganism of the Japanese origin, but was frequently from the Thailand origin.

17904 (NP—8770044, pp 485-497) **Development of fuel alcohol technology. Development of attached bacterial cell process.** Kamino, Yasuyoshi. (Hitachi Zosen Corporation, Osaka, Japan). 21 Sep 1984. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

In Proceedings of parallel sessions for the 4th NEDO general assembly.

In order to establish a fuel alcohol production technology, research and development was made on the process and the equipments as well as the searching and breeding of excellent bacteria. Research items for 1983 and the results are as follows: 1) Study on the attached bacterial cell process Batch fermentation rate was tested for various materials indicated that the black sugar showed the same level of fermentation rate as that of glucose. 2) Performance evaluation test: A test unit consisting of two acrylic resin fermentation vessels was made and data on its structure was obtained. Fermentation test of cane black strap molasses without cooking gave the fermentation yield of 87 % and alcohol productivity of 27 g/1-h. 3) Manufacture of a test plant: A test plant of alcohol production with 100 1/d capacity was designed and manufactured in the plant of Ryukyu Seito Co., Okinawa Prefecture. (10 figs, 3 tabs)

17905 (NP—8770044, pp 498-524) **Development of fuel alcohol technology. Development of flash fermentation method.** Yamada, Tomiaki. (JGC Corporation, Tokyo, Japan). 21 Sep 1984. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

In Proceedings of parallel sessions for the 4th NEDO general assembly.

In order to develop a new process which gives high alcohol productivity as well as energy-saving feature. This development aims at realizing an industrial unit by combining a flasg fermentation method to the conventional, continuous fixed yeast fermentation technology. Items studied in 1983, the first year of this project, were the following two: (1) Basic studies made on flash fermentation: Establishment of an optimum flushing condition. Process construction. Bacteria densification suited for flash fermentation. Characteristics of high salt concentration fermentation. Retention of highly efficient fermentation characteristics. (2) Design of a bench unit: On the basis of installing a bench unit of 5 kl/d alcohol production at Izumi alcohol plant of NEDO, basic specifications on the design and process flow sheets were prepared. (17 figs, 8 tabs)

17906 **Biofuel cycles: Economic status and cost projections.** Gaines, L.L.; Flaim, S.J.; Wallace, C.J. (Argonne National Lab., Argonne, IL). pp 951-955 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—). Contract W-31-109-ENG-38.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879011.

The Biofuels and Municipal Waste Technology Division of the U.S. Department of Energy focuses on increasing the biomass available for fuel production and on integrated fuel cycles that produce liquid and gaseous fuels. This research is in contrast to most renewable energy technologies, which produce heat or electricity. This paper describes the fuel cycles under study, examines their economic status and cost goals, and addresses technically challenging areas where major improvements are required to yield cost-competitive fuel products. The technologies described are projected to be ready for private-sector development and commercial use in the mid-to long-term. The technical and economic goals presented are based on current information and are subject to periodic review and revision.

0903 Inorganic Hydrogen Compound Fuels

17907 **Effects of aluminum oxide in restructuring iron single crystal surfaces for ammonia synthesis.** Strongin, D.R.; Bare, S.R.; Somorjai, G.A. (Lawrence Berkeley Lab., CA). *Journal of Catalysis;* **103**: No. 2, 289-301(Feb 1987). Contract AC03-76SF00098.

The effect of aluminum oxide and potassium on the ammonia synthesis over the (111), (100), and (110) faces of iron has been investigated. A restructuring of the Fe(110) and Fe(100) surfaces, induced by the presence of aluminum oxide and 20 Torr of water vapor, takes place making the restructured surfaces almost as active as the clean Fe(111) plane in the ammonia synthesis reaction (20 atm reactant pressure of hydrogen and nitrogen). The high activity of the restructured surfaces is maintained for over 4 hr of ammonia synthesis. Without the presence of aluminum oxide, treatment of the Fe(110) and Fe(100) surfaces with 20 Torr of water vapor again produces restructured surfaces which are almost as active as the Fe(111) plane for a short period. However, in this case deactivation of the restructured surfaces into the respective clean, unrestructured surfaces occurs within 1 hr of ammonia synthesis. Restructuring of the Fe(111) with 20 Torr of water vapor produces only a slight decrease in ammonia synthesis activity. The enhancement in rate of the restructured Fe(110) and Fe(100) surfaces, with or without aluminum oxide, might be explained by the formation of active surface orientations for ammonia synthesis (i.e., Fe(111) and Fe(211)), which contain C_7 sites (iron atoms with seven nearest neighbors), during the water vapor treatments. These restructured surfaces are only stable in the ammonia synthesis conditions when aluminum oxide is present. Potassium adsorbed alone or with coadsorbed aluminum oxide exhibits no promotional effects under the water vapor pretreatment conditions used in this study.

17908 **Importance of C_7 sites and surface roughness in the ammonia synthesis reaction over iron.** Strongin, D.R.; Carrazza, J.; Bare, S.R.; Somorjai, G.A. (Lawrence Berkeley Lab., CA). *Journal of Catalysis;* **103**: No. 1, 213-215(Jan 1987). Contract AC03-76SF00098.

In this note the authors present data which further supports the contention that C_7 sites (Fe atoms with seven nearest neighbors) are those most active in iron ammonia synthesis catalysts. Previous work in their laboratory showed that the synthesis of ammonia from its elements is a very structure sensitive reaction. It was found that the relative order of activity for ammonia formation was Fe(111) > Fe(100) > Fe(110). High pressure kinetic results presented here of ammonia synthesis over Fe(210) and Fe(211) surfaces in addition to the Fe(111), Fe(100), and Fe(110) surfaces show that the presence of highly coordinated sites is more important than surface roughness for high catalytic activity. 11 references.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 18548

13 HYDRO ENERGY

REFER ALSO TO CITATION(S) 18401

17909 **(CONF-8711117—1) An overview of conflict and competition between water for irrigation and energy generation.** Waddle, D.B.; Perlack, R.D. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003777/JAW.

From Workshop on water management for non-traditional high value crops; Santo Domingo, Dominican Republic (22 Nov 1987).

This paper reviews the political and technical issues concerning conflicts between water use for irrigation and energy generation. It focuses on a specific case in the Dominican Republic, drawing on historical experience in the United States, and finally extrapolates this experience to other countries in the Caribbean and Latin American region. Coupling the growth in irrigation facilities with growing demand for electricity and the declining ability of developing countries to finance new power generating facilities, this problem could expand to a more important issue within this region and to other developing countries in general. 15 refs., 10 tabs.

17910 **(DOE/CE/15309—T2) [Evaluation of the Flash Gate Board project]: Progress report, [September-November 1987].** (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA). Dept. of Mechanical Engineering). 15 Dec 1987. Contract FG01-87CE15309. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004027/JAW.

Effort continues in the development of the mathematical model for the Flash Gate System. Refinements have been added to improve the utility of the model. One of the difficult aspects of modeling the Flash Gate under conditions of dynamic operation concerns the amount of water which is considered to move with the gate and thus contribute to the inertia of the gate. The variable moment of inertia of the gate and water as a function of gate angle was reexamined. A new formulation model for the "virtual" inertia as a function of gate angle was developed. This new formulation allows less water to move with the gate. The reduced mass of water results in lower inertia at all gate angles hence increasing the natural frequency of the system. This new model for the inertia was incorporated into the previous models and new results where generated to replace results with the previous inertia formulation. The natural frequency and damping characteristics of the gate system were examined as functions of the gate angle and water depth using the new model. 5 figs.

1305 Economics And Management

17911 **(DOE/BP/12660—4) 1985 Libby Reservoir angler census, May 13-October 31, 1985: Interim report.** Chisholm, I.; Hamlin, P. (Montana Dept. of Fish, Wildlife and Parks, Kalispell (USA)). May 1987. Contract AI79-84BP12660. 105p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005200/JAW.

An intensive creel and economic survey was conducted on Libby Reservoir from May 13 through October 31, 1985. This research was part of a larger effort to quantify the existing reservoir fishery and the effects of dam operation on this fishery. Census techniques incorporated direct interviews and electronic car counters installed at all established boat ramp access sites. A total of 4243 angling party interviews, 2379 car counter interviews and 719 economic surveys were conducted on Libby Reservoir. Interviewed anglers fished for 52,146 hours. Estimated pressure was 518,916 hours or 93,500 angler days equivalent to 2.10 angler days per acre. Eight percent of the total estimated angler days or 7436 fishing grips occurred on the Canadian portion of the reservoir. Boat anglers expended over 96% of the total effort. Anglers caught

an estimated 617,097 fish during the creel period, 97% (597,380 fish) of which were kokanee. The majority (98%) of the kokanee harvested were caught on the US portion of the reservoir. Harvest of Salmo spp. was estimated at 15,334 fish. Whitefish and brook trout harvest was estimated at 1273 and 48 fish, respectively. Non-game fish species were almost nonexistent in the creel and estimated harvest was less than 0.5% of the total harvest.

1306 Environmental Aspects

17912 (DOE/BP—905) Columbia River Basin Fish and Wildlife Program Work Plan for fiscal year 1988. (USDOE Bonneville Power Administration, Portland, OR. Div. of Fish and Wildlife). Oct 1987. 220p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88005292/JAW.

The FY 1988 Columbia River Basin Fish and Wildlife Program Work Plan (Work Plan) presents Bonneville Power Administration's plans for implementing the Columbia River Basin Fish and Wildlife Program (Program) in FY 1988. The Work Plan focuses on individual Action Items found in the amended Program for which Bonneville Power Administration (BPA) has determined it has authority and responsibility to implement. The FY 1988 Work Plan emphasizes continuation of 95 ongoing projects, most of which involve protection, mitigation, or enhancement of anadromous fishery resources. These continuing activities are summarized briefly by Program area: (1) mainstem passage; (2) artificial propagation; (3) natural propagation; (4) resident fish and wildlife; and (5) planning activities.

17913 (DOE/BP/62775—2) Wildlife protection, mitigation, and enhancement plans: Anderson Ranch and Black Canyon Facilities: Final report. Meuleman, G.A.; Hansen, H.J.; Martin, R.C. (Idaho Dept. of Fish and Game, Boise (USA)). Jun 1987. Contract AI79-86BP62775. 102p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005294/JAW.

Under direction of the Pacific Northwest Electric Power Planning and Conservation Act of 1980, and the subsequent Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program, projects have been developed in Idaho to mitigate the impacts to wildlife habitat and production due to the development and operation of the Anderson Ranch and Black Canyon Facilities (i.e., dam, power plant, and reservoir areas). The Anderson Ranch Facility covered about 4812 acres of wildlife habitat while the Black Canyon Facility covered about 1115 acres. These acreages include dam and power plant staging areas. A separate mitigation plan has been developed for each facility. A modified Habitat Evaluation Procedure (HEP) was used to assess the benefits of the mitigation plans to wildlife. The interagency work group used the target species Habitat Units (HU's) lost at each facility as a guideline during the mitigation planning process, while considering the needs of wildlife in the areas. Totals of 9619 and 2238 target species HU's were estimated to be lost in the Anderson Ranch and Black Canyon Facility areas, respectively. Through a series of projects, the mitigation plans will provide benefits of 9620 target species HU's to replace Anderson Ranch wildlife impacts and benefits of 2195 target species HU's to replace Black Canyon wildlife impacts. Target species to be benefited by the Anderson Ranch and/or Black Canyon mitigation plans include the mallard, Canada goose, mink, yellow warbler, black-capped chickadee, ruffed grouse, mule deer, blue grouse, sharp-tailed grouse, ring-necked pheasant, and peregrine falcon.

1307 Power-conversion Systems

17914 (PNL—6426) Factors affecting the failure of copper connectors brazed to copper bus bar segments on a 615-MVA hydroelectric generator at Grand Coulee Dam. Atteridge, D.G.; Klein, R.F.; Layne, R.; Anderson, W.E.; Correy, T.B. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1988. Contract AC06-76RL01830. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005481/JAW.

On March 21, 1986, the United States Bureau of Reclamation experienced a ground fault in the main parallel ring assembly of Unit G19 - a 615-MVA hydroelectric generator - at Grand Coulee Dam, Washington. Inspection of the unit revealed that the ground fault had been induced by fracture of one or more of the copper connectors used to join adjacent segments of one of the bus bars in the north half of the assembly. Various experimental techniques were used to detect and determine the presence of cracks, crack morphology, corrosion products, and material microstructure and/or embrittlement. The results of these inspections and recommendations are given. 7 refs., 27 figs.

14 SOLAR ENERGY

REFER ALSO TO CITATION(S) 17654, 18401

17915 (DOE/CE—0205) Renewable technologies program summaries, FY 1988. (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of the Deputy Assistant Secretary for Renewable Energy). 1988. 58p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE88005781/JAW.

Federal involvement in renewable energy R and D focuses on long-term needs to achieve national policy goals. Industry tends to focus on short-term rather than long-term activities and is generally reluctant to invest in projects that do not produce tangible benefits in the near term. The Federal Government, on the other hand, sets long-term R and D priorities for energy security and fills the gaps in the early phases of high priority R and D that industry is not willing or able to undertake. The continuum of DOE funded research - from basic, to applied, to proof of concept - is maintained through multi-year commitments, with the DOE role varying along the continuum. The DOE program provides for industry involvement in determining long-term research needs, sponsors the research needed to address these priorities in collaboration with industry, and disseminates research results. The energy marketplace and private industry are best suited to develop and produce near-term renewable energy technologies at rate consistent with their market viability and suitability. This report describes the specific research activities that will be undertaken during Fiscal Year 1988 in each individual program, and the results expected from those activities.

17916 (NP—8770046, pp 411-416) Research and development for evaluation system of solar cell. Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

In order to evaluate the performance and capability of solar cell properly and impartially, the evaluation systems for the performance and reliability have been assured. The results are as follows. 1. Development for performance evaluation method; (1) The international comparisons of standard solar cell calibration methods and our method has been assured to be mostly near to the average value. (2) Experimental solar cell has been made and the indoors and outdoors evaluation of solar cell module have become to be possible with same accuracy. (3) As the spectro-radiometer of high performance have been developed, the measurements of the output of the solar cell module have become possible, monitering spectrum of wide range of natural solar beam. (4) With use of several kinds of standard solar cell, measurement errors have been assured. (5) As for nominal operating cell temperature of module, experimental researches have been done indoors and outdoors and the diffeneces have been assured. 2. Development of reliability evaluation method; (1) In outdoor exposure test, the basic data of the accelerating degradation test have been accumulated and it has been assured that the degradation of crystal type is few. (2) By the acceleration degradation test with use of weathermeter, and temperature and humidity cycling test device, the proceses of degradation have been assured. (3) In the processes of enviromental tests and mechanical strength tests, remarkable degradation has not been recognized.(1 tab)

17917 (NP—8770046, pp 417-418) Research and development for evaluation system of solar cell. Remote area supply system. Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

With the objects of constituting renewable energy system suitable for supplying electric power in distant territories in Australia, drafting the design of the general description and estimating construction cost and technical and economical possibilities, the design of general description and the estimation of components cost for the economical evaluation, persuiting the adaptive system to each prospecting territory. Also the investigations of the prospecting territory were done.

17918 **(SERI/SP—272-3201) Solar energy technical publications catalog: Solar thermal technology.** (Solar Energy Research Inst., Golden, CO (USA)). Sep 1987. Contract AC02-83CH10093. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001127/JAW.

The research and development described in these documents was conducted within the US Department of Energy's (DOE) Solar Thermal Technology Program. The goal of this program is to advance the engineering and scientific understanding of solar thermal technology and to establish the technology base from which private industry can develop solar thermal power production options for introduction into the competitive energy market. This catalog represents part of an effort to provide information on publications about solar thermal research and development activities conducted by DOE's laboratories. Publications listed include technical and research reports and special publications.

1401 Resources And Availability

17919 **(AD-A—186084/0/XAB) Use of the direct measurement of solar radiation for the determination of Pasquill stability parameter. Technical report, January-August 1984.** Myirski, M.M. (Chemical Research, Development and Engineering Center, Aberdeen Proving Ground, MD (USA)). Jul 1987. 37p. (CRDEC-TR—87065). NTIS, PC A03/MF A01.

Two schemes for estimating the amount of solar radiation received at the earth's surface are compared to solar-radiation measurements. These data were acquired over a total of 25 days and from 214 individual observations. These observations were grouped into both instantaneous and hourly averaged data. Of the two schemes studied, the insolation parameter Psi performed better than the net radiation index used in the Pasquill-Turner Stability Category algorithm. To eliminate the need to subjectively estimate the amount of solar radiation, an algorithm is presented to determine a continuous Pasquill stability parameter based on direct measurement of solar radiation. This algorithm compares favorably to one previously developed by Great Britain's meteorological office.

17920 **(FRNC-CONF—257) Meteorology and renewal energies.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). Mar 1984. 869p. (In French). (CONF-8403250—). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88751078/JAW.

From AFME colloquium on meteorology and renewable energies; Valbonne, France (18 Mar 1984).

This seminar is divided into four main topics: development and improvement of meteorological measurements for energy applications (new observed data, accuracy improvement), consultation and cooperation between the meteorological institutes and the meteorological data users (agriculture, building design and renewable energy systems) in order to improve data utilization; in the third and fourth part of the seminar, the data acquisition and processing problems are illustrated: solar radiation and atmosphere coupling and its effects on the radiation magnitude and spatial and spectral distribution, wind datas, tropical countries meteorological data acquisition by satellites.

17921 (NP—8770046, pp 464-471) **Research and development of peripheral technology. Basic research of power output.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is the report of the achievement in 1985 about the research on the insolation along the slope on the installation surface of solar cells. The 15 month test observations with the objective of acquiring the data for the research of the insolation estimation method was completed and at the same time, by measuring the characteristics of the pyrheliometer and comparing it with the reference of the Meteorological Agency, the hourly data were corrected. Various models for determining the estimation method of the average monthly insolation were evaluated using these data above and it was found that the rb model is the best for the direct reaching component and the Hay2 model is for the sky scattering component. The method of estimating reduced insolation due to obstacles was studied and its effectiveness was confirmed by using the hourly distribution rate model for the direct reaching insolation and the form coefficient for the sky scattering insolation. In addition, from the whole sky insolation and the scattering ratio at 153 meteorological stations and 688 AMEDAS spots in Japan, the locations of the boundary lines of insolation climate regions were determined and 5 areas of the large climate region, 11 areas of the middle climate region, 26 areas of the small climate region and 7 spots of the special region were established. At the same time, climatic tables and climatic maps were prepared.

1403 Economics

REFER ALSO TO CITATION(S) 18030

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 17900, 17901, 17902, 18008, 18011, 18014, 18021, 18033, 18047, 18812, 19113, 19389, 19390, 19646

17922 **(CONF-871112—3) Progress of amorphous silicon based solar cells and modules.** Stone, J.L. (Solar Energy Research Inst., Golden, CO (USA)). 1987. Contract AC02-83CH10093. 18p. NTIS, PC A03. Order Number DE88004666/JAW.

From 3. international photovoltaic science and engineering conference; Tokyo, Japan (3 Nov 1987).

It is clear that amorphous silicon photovoltaic technology has entered a new era, having emerged from the research labs to commercialization of energy producing applications. Although effort still must be placed on improving the device performance, more emphasis is now being devoted to questions of cost and reliability. More system and subsystem experiments are being deployed to gain field experience with this relatively new technology. This is particularly true with the US utility companies who are examining PV for consideration as a future generating option. What was only a few years ago a promise, is now becoming a reality. This paper reviews significant accomplishments in research and technology in the United States' research and production community. 14 refs., 5 figs., 5 tabs.

17923 **(EUR—11118) Photovoltaic power generation: European research and development: Contractors' catalogue.** Palz, W.; Caratti, G. (eds.). (Commission of the European Communities, Brussels (Belgium)). 1987. 99p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88900399/JAW.

This catalogue contains two-page summaries of the results obtained in the contracts on photovoltaic power generation R and D, which were concluded between the Commission of the European Communities, Directorate-General XII: Science, Research and Development, Brussels, and a number of public and private research institutions in the European Community.

17924 **(N—88-11966) Recent progress in space photovoltaic systems.** Brandhorst, H.W. Jr.; Flood, D.J.; Weinberg, I. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Oct 1987. 13p. (NASA-TM—100208; E—3807; NAS—1.15:100208; CONF-871112—). NTIS, PC A03/MF A01.

From 3. international photovoltaic science and engineering conference; Tokyo, Japan (3 Nov 1987).

Key issues and opportunities in space photovoltaic research and technology relative to future NASA mission requirements and drivers are addressed. Examples are given of space missions and/or

operational capabilities on NASA's planning horizon presenting major technology challenges to the use of photovoltaic power generation in space. The status of cell R and D and the performance goals to be met by space photovoltaic power systems to remain competitive are described.

17925 **(N—88-12429) Low earth orbit environmental effects on the space station photovoltaic power generation systems.** Nahra, H.K. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1977. 20p. (NASA-TM—100230; E—3852; NAS—1.15:100230; CONF-880457—). NTIS, PC A03/MF A01.

From American Society of Mechanical Engineers Solar Energy Division conference; Golden, CO, USA (10 Apr 1988).

A summary of the Low Earth Orbital Environment, its impact on the photovoltaic power systems of the space station and the solutions implemented to resolve the environmental concerns or issues are described. Low Earth Orbital Environment (LEO) presents several concerns to the photovoltaic power systems of the space station. These concerns include atomic oxygen interaction with the polymeric substrate of the solar arrays, ionized environment effects on the array operating voltage, the effects of the meteoroids and debris impacts and penetration through the different layers of the solar cells and their circuits, and the high energy particle and radiation effects on the overall solar array performance. Potential solutions to some of the degrading environmental interactions that will provide the photovoltaic power system of the space station with the desired life are also summarized.

17926 **(N—88-12877) Performance of GaAs and silicon concentrator cells under 37 MeV proton irradiation.** Curtis, H.B.; Swartz, C.K. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 10p. (NASA-TM—100144; E—3696; NAS—1.15:100144; CONF-870528—). NTIS, PC A02/MF A01.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Gallium arsenide concentrator cells from three sources and silicon concentrator cells from one source were exposed to 37 MeV protons at fluences up to 2.8 x 10 to the 12th protons/sq cm. Performance data were taken after several fluences, at two temperatures (25 and 80 C), and at concentration levels from 1 to about 150 x AMO. Data at one sun and 25 C were taken with an X-25 xenon lamp solar simulator. Data at concentration were taken using a pulsed solar simulator with the assumption of a linear relationship between short circuit current and irradiance. The cells are 5 x 5 mm with a 4-mm diameter illuminated area.

17927 **(N—88-12878) Radiation performance of AlGaAs concentrator cells and expected performance of cascade structures.** Curtis, H.B.; Swartz, C.K.; Hart, R.E. Jr. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 11p. (NASA-TM—100145; E—3697; NAS—1.15:100145; CONF-870528—). NTIS, PC A03/MF A01.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Aluminum gallium arsenide, GaAs, silicon and InGaAs cells have been irradiated with 1 MeV electrons and 37 MeV protons. These cells are candidates for individual cells in a cascade structure. Data is presented for both electron and proton irradiation studies for one sun and a concentration level of 100X AMO. Results of calculations on the radiation resistance of cascade cell structures based on the individual cell data are also presented. Both series connected and separately connected structures are investigated.

17928 (NP—8770039, pp 170-187) **Research cooperation on photovoltaic power generation system for village in Indonesia.** Takeya, Koreyuki. (Kyocera Corp., Kyoto, Japan). 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

The objectives of this cooperation are to construct a pilot plant of photovoltaic power generation system in Indonesia, to carry out endurance tests, operation and evaluation of solar cell modules, supporting mounts and storage batteries, and to make the most appropriate application to the environmental conditions of Indonesia of the technology concerning the independent dispersed-type photovoltaic power generation system which is now under research and development in Japan. In 1984, field surveys and the establishment of a meteorological observation system were done and in 1985, a water pump system was designed and constructed. The meteorological observation system consists of respective sensors for insolation, air temperature and humidity, a rain gauge, a data collector and a memory cassette. An average insolation for 90 days is 4.18 KWh/m² per day which, irrespective of the Indonesian rainy season, is about 1.3 times more than the average a year in Tokyo. This shows that the insolation conditions there are pretty good. A water pump system pumps up water from the water source in a cave by driving an electric motor by solar batteries. (17 figs, 5 tabs)

17929 (NP—8770044, pp 137-163) **Research and development of photovoltaic power generation system. Cast wafer process technology.** Tabata, Kazuyoshi. (Osaka Titanium Co. Ltd., Amagasaki, Japan). 21 Sep 1984. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

In Proceedings of parallel sessions for the 4th NEDO general assembly.

An operation study of an experimental fabrication unit of a cast substrate which had already been installed was carried out to find the following results. (1) In casting granular SOG-Si, such problems as bridging at charging and dissolving, occurence of undissolved portion and mass, could be avoided by selecting a proper stripping agent and by adjusting a charging rate or melting temperature. Some of the silicon nitride of the Japanese-make were as good as the US-make. In addition, an ingot of 430 mm diameter could be produced. (2) As a wafer processing technique, slicing by means of a multi-wire saw process was found superior. (3) Life time of the experimental wafer exceeded 2 microseconds, a temporary standard. It was also found that wafer cutting direction for the ingot size of this experiment did not need to be vertical to the direction of coagulation. (22 figs, 9 tabs)

17930 (NP—8770044, pp 164-183) **Practical research on amorphous solar cells. Large area production technology.** Uchida, Yoshiyuki. (Fuji Electric Corporate Reserch and Development Ltd., Kawasaki, Japan). 21 Sep 1984. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

In Proceedings of parallel sessions for the 4th NEDO general assembly.

Improving research on the film making by means of an IVE type large area amorphous silicon (a-Si) forming unit, and a basic study on a transparent electrode and a back-surface electrode was carried out as well as design and trial-making of a solar cell with an aim to attain large-area and high-conversion efficiency. As a result, a conversion efficiency of 9.2 %, 8.0 %, and 4.5 % respectively for the area of 1 cm², 100 cm², and 600 cm² was attained. Other items of study were development of evaluating the growth mechanism of a doping film and its characteristics, oxygen-content as an impurity in a-Si film and its influence to the film characteristics, accumulation of various data for designing a module structure as well as manufacturing technology of a module, a laser scanner unit for analyzing the distribution of the characteristics within the surface. (16 figs)

17931 (NP—8770045, pp 143-161) **Results of development and interim evaluation of solar cell manufacturing technology.** Ikeda, Shigeru. (New Energy Deveropment Organization, Tokyo, Japan). 20 Sep 1985. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

In Proceedings of parallel sessions for the 5th NEDO general assembly.

Concerning the manner of developing a solar cell manufacturing technology, an interim report in Aug, 1983 titled New Development in the Sun Shine Project gave the interim targets to be attained by 1985. This report deals with a 1985 interim evaluation of the following two studies carried out by NEDO. (1) Development of crystalline solar cell manufacturing technology: With the

aim of cost reduction and development of commercialization technology, development of a technology of a continuous, through production level was carried out. This development included a technology of producing silicon for a solar cell, substrate production, PN-junction, and the panel assembly. (2) Commercialization research on amorphous solar cell: Items studied are low cost production of mono-silane, production of uniform, large area product, etc. in the purpose to attain higher conversion efficiency and reliability for the power application. (1 fig, 3 tabs)

17932 (NP—8770045, pp 162-181) **Practical research on amorphous solar cells for electric power. High efficiency production technology.** Kuwano, Yukinori. (Sanyo Electric Co. Ltd., Moriguchi, Japan). 20 Sep 1985. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

In Proceedings of parallel sessions for the 5th NEDO general assembly.

This is a report of a NEDO project since 1983 on the commercialization of power-use amorphous solar cell. By adopting a new forming method, a continuous separation forming plasma reaction process, and aiming at higher efficiency of an amorphous solar cell, a conversion efficiency at the world top level of 11.5 % for 1 cm^2 cell and 9.3 % for 10 cm square integrated cell was attained. Development was made on a technology, high speed and highly efficient in forming an amorphous solar cell, such as high speed film forming technology, patterning technology of integrated solar cell by laser fabrication. (14 figs)

17933 (NP—8770045, pp 182-200) **Practical research on amorphous solar cells for electric power. High quality production technology.** Yukimoto, Yoshinori. (Mitsubishi Electric Corporation, Tokyo, Japan). 20 Sep 1985. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

In Proceedings of parallel sessions for the 5th NEDO general assembly.

This is a report of a NEDO project for the commercialization of power-use amorphous solar cell, consisting of studies on production technology of amorphous material, modulation technology, electrode-forming technology, and reliability technology. Since a unit of growing an amorphous semiconductor material for multi-layer tandem construction was started operating in 1984, a nip-type multi-layer construction, which had been optimized by a single-chamber growth unit, was switched to a pin-type multi-layer construction in order to attain more reliability. Results are as follows: (1) All chambers of the continuous growth unit for the amorphous for a tandem construction were completed and put into operation. (2) An experimental model of a pin three-layered tandem construction cell was made, whose conversion efficiency was 8 % for a 10 cm square cell. (3) Film formation of a p-layer was studied. Low temperature film formation improved the p/i interfacial characteristics. (4) Pin construction was found superoir in reliability. (18 figs)

17934 (NP—8770046, pp 237-242) **Development of commercialization technology of photovoltaic power generation. Development of low-cost chlorosilane production technology.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

Recycling of effective component of reactor-extracted particles was investigated for the cost reduction of chlorosilane production. a) By converting the two-tower system of fractionation into the one-tower system (No.1 tower only), steam consomption decreased from 5.6 t/t TCS (Trichlorosilane) to 4.0 t/t TCS. TCS quality was 40 - 90 ohm-cm for p-type. b) By adding one unit of cyclone to the original one unit in order to improve the metal silicon unit, 70.2 kg/t TCS decreased down to 56.2 kg/t TCS. c) In the investigation of optimum fluidized reaction conditions, capacity of the raw material feed pump was raised, and the relation between the molar ratio and the crude TCS production was investigated. Less molar ratio reduced the conversion ratio,but improved the production rate of crude TCS and the electricity unit. (2 tabs)

17935 (NP—8770046, pp 243-250) **Development of commercialization technology of photovoltaic power generation. Development of low-cost chlorosilane production by rapid cooling process.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

Investigation on the technology of producing low-cost and stanbe trichlorosilane was made by producing STC (silicon tetrachloride) from the domestic silica stone and by the successive hydrogenation. In the production technology of STC: a) Strength of the raw material pellet increases as the content of organic matters in the binder increases. b) Bridging of the raw material pellet is prevented by making a sleeve in the reactor to an inverted taper type. Prospect for a long continuous operation was obtained by the result. c) Yield of crude STC (chlorine basis) was 91 % while the target had been 90 %. d) In the production technology of trichlorosilane, graphite rings packed in the reactor for improving the heat transfer improved the conversion factor by 1%. In this case, however, the heat transfer among the graphite rings was not sufficient, although the gas mixing was improved. (2 figs, 1 tab)

17936 (NP—8770046, pp 251-256) **Development of commercialization technology of photovaltaic power generation. Development of production technology of high-purity silica and silicon.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is an annual report for 1985 on the project of developing the production technology of high-purity silicon from silica by physical and chemical purification. As to the high-purity silica production technology, a continuous 10-day experiment was carried out using water glass available in the market by means of a continuous purification unit based on a fine particle process. The production of 10 - 12 kg/d of high-purity silica was attained. In order to investigate the silicon production technology based on the reduction of high-purity silica, further modification was made to the special furnace (installed in 1954) to enable such a long continuous operation of about 50 hours. As to the production technology of high-purity reducing agent, a prospect was obtained to produce a reducing agent enclosing silica in its central region by thermo-decomposing the hydrocarbon in the fluidized silica layer using an experimental equipment. (2 tabs)

17937 (NP—8770046, pp 257-261) **Development of commercialization technology of photovoltaic power generation. Development of technology of chlorosilane hydrogenation process.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is an annual report for 1985 for the project on silicon production for solar cell by chlorosilane hydrogenation. Research on the model plant operation of 10 t/y level was continued to verify the long-term continuous operation using the conventional reaction tube and to confirm the quality limit of the granules. By this experiment, 7,746 kg of granules were produced in 3,420 total hours. Overall operation result was as follows: Electricity unit; 23.55 kwh/kg. TCS unit; 19.24 kg/kg Si. Yield of Si; 20.74 %. Quality of the granules produced got stabilized with longer continuous operation time. As to the large reaction tube, 6 reaction tubes of the conventional size were fabricated. Two of them were subjected to an endurance test by 10 t/y class equipment. By this it was estimated that higher strength could be obtained than the conventional tubes. On the other hand, a basic experimental unit of SiC-CVD equipment was made to start an experiment on the CVD reaction. Factors on the rate of precipitation adhesion were obtained, and the formation of strong CVD film was confirmed to be possible. (4 tabs)

17938 (NP—8770046, pp 262-263) **Development of commercialization technology of photovoltaic power generation. Development of technology of chlorosilane hydrogenation process (survey on SOG silicon production technology).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is an annual report for 1985 on the production technology of silicon for solar cell in connection with future prospect of the practicable low-cost production technology. 1. Study on elemental technology; Details of 9 fields of elemental technology required for the production of SOG silicon from raw material were clarified. 2. Overseas survey; Processes as HPS process by ENI group, Italy, Siemens D process by Siemens, West Germany, metal silicon purification process and aluminum-reduction of quarz process by Wacker-Heliotronic, West Germany, and Silcer process by Elkem, Norway were selected and investigated to clarify their technology level and destinctive features. 3. Study on economical efficiency of the solar cell system; Concepts, method of calculation, and the present estimation on module cost, BOS cost, solar electricity generation cost, system demand cost, and evaluation method of economical efficiency, etc. were clarified in order to reflect on the evaluation of SOG silicon production technology.

17939 (NP—8770046, pp 264-270) **Development of commercialization technology of photovoltaic power generation. Technology development of cast substrale production process for solar cell.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is an annual report for 1985 on the technology development project for cast substrate production process. 1. Casting technology; In the study of operating the batch-type casting furnace, cell conversion efficiency of the solar cell module for electricity generation system was 13.4 % in average. In the study of operating the continuous-type casting furnace, a stable operation of maximum 6 consecutive runs was confirmed. With optimum combination of conditions, the quality of the ingot varied little from top to bottom, and the conversion efficiency was 11 - 12 %. In the production study of 30 cm square ingot (9 substrates), weight of ingot obtained was approximately 60 kg, and the electricity consumption was also improved up to 70 % as compared with that required for 20 cm square ingot. 2. Processing technology; In the external shaping process, the 30 cm square ingot was not cracked. In the slicing process, relative cost of wire was one quarter of that of 1984, and cost of abrasive was reduced by approximately 40 %. Improvement in the wire-saw enabled the continuous operation of approximately one month to produce about 10,000 pieces of wafers, wherein the yield reached the level of 95.3 % average. (3 figs, 1 tab)

17940 (NP—8770046, pp 271-277) **Development of commercialization technology of photovoltaic power generation. Verification on experimental production of solar cell panel by spin-process.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is an report for 1985 on the technology development project for cast substrate production by the spin-process. To reduce weight, thickness of the cavity mold was decreased, and the taper angle was changed to prevent the overflow of silicon. Sheet producting conditions was optimized in accordance with the improvement of the mold module, and a coating technology of the cavity mold was developed. Panels were trially made by the spin-process from 44 pieces of 10 cm square cells, and the panel with 48.6 W maximum output was found to have cleared efficiency of 11 % per cell. Single-cavity type mold module was trially made in which the mold module was divided into 4 cavity molds. This module greatly increases the speed of raising the temperature of the mold body. Five times of productivity can be expected as compared with the conventional type mold. An experimental unit was designed aiming at improving the productivity of 10 cm square silicon polycrystal sheet, and a hot-zone heating system and rated output are tabulated. (6 figs, 4 tabs)

17941 (NP—8770046, pp 278-283) **Development of commercialization technology of photovoltaic power generation. Verification on experimental production of solar cell panel (ribbon crystal wafer process).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This study was performed as one of research projects funded by NEDO. And the study is aimed at a development of a ribbon crystal substrate working process as one of the Rand D items required for the low cost mass-production of solar electric cell panels. And on the manufacture of a ribbon crystal substrate, a study was made on a long time pulling of ESP ribbon crystal without using a conventional capillary die. Further, on the ribbon crystel substrate, it was determined to study the the characteristics and obtain the basic knowledge to raise the level of quality. Namely, on the manufacture of the ribbon crystal base plate, a method for winding a string around the lower pulley and an amount of tension to be added to the string was studied and a favorable result was obtained. On the speed up of the ribbon crystal a thermal shield made of porous carbide was kept in close contact with an external wall of the crucible to prevent solidification of the solution even if the temperature of the solution is lowered. In consequence, the raising speed became 2.5 cm/min. On purification of the ribbon crystal the ESP Process and an elongation of carrier lifetime were studied. And the substrate produced was fed PN junction process to obtain evaluation data. By means of a method such as the purification of carbon members, the concentration of inpurities in ribbon crystal were lowered. (1 tab)

17942 (NP—8770046, pp 293-302) **Development of commercialization technology of photovoltaic power generation. Verification on experimental production of solar cell panel (wet PN junction process).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This study was performed as one of research projects funded by NEDO. And the study is aimed at a development of wet PN junction process as one of the R and D items required for the low cost mass-production of solar electric cell panels. And using a low cost operating condition optimized by the previous fiscal year, an evaluation on a SOG substrate was performed. In the meantime, based on the result obtained by a study to improve the process, an element technology was developed for a new working system in each working process applicable for a large scaled plant to be built in the future. In order to decrease the cost (per wp) of the solar electric cell panel, improvements on characteristics are important, and in this fiscal year in particular an engineering development was carried out with a main objective to obtain an element having a high conversion efficiency, nevertheless a basic working process of the pilot line was invariably used. On the operation research, following the line of 1984 fiscal year, a SOG cast substrte and SOG ribbon substrate (SEG partially) were introduced, and a characteristic evaluation was performed for each lot, and subsequently 1,850 sheets of completed elements were transported to the suceeding working process as scheduled for the SOG cast. For the manufacture of the silicon ribbon substrate, Edge Supported Pulling Process was adopted. As a part of the study on work process improvements, a TiO_2 reflection preventing membrane by a normal pressure CVD Process was developed, and the improvements on the element characteristic were attempted. (5 figs, 3 tabs)

17943 (NP—8770046, pp 303-314) **Development of commercialization technology of photovoltaic power generation. Verification on experimental production of solar cell panel (panel assembly process technology).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This study was performed as one of research projects funded by NEDO. And the study is aimed at a development of a panel assembly process as one of the R and D items required for the low cost mass-production of solar electric cell panels. And R and D for a cell arrangement joint process, a panel package working process and inspection work process, and the plant system were carried out, and simultaneously the following operation research was performed: (1) An operation research for the evaluation of the solar electric cell element panel. (2) A study on a low cost panel as an internal work process research. In consequence, following results were obtained: (1) On the cell arrangement joint process research, a study was performed to raise a productivity by speeding up the operation of the unit, and the purpose was achieved. (2) On the panel package working process, the component elements that had been separated to the lead of strings and the output lead, were combined to form one unit, and thereby the working time was decreased and

the quality was improved. (3) On the inspection work and plant system research, by comparing the measured data by the solar light and that derived from the solar simuator on Pmax it was found that the one measured by the solar light was higher by 1.2 - 8.5% under a standard condition. (1 fig)

17944 (NP—8770046, pp 315-321) **Commercial application of amorphous solar cells. Production of low-cost monosilane.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This study was performed as one of researches funded by NEDO. And the study was intended to develop a test facility of 10 ton/year capacity in order to find a practical production method using a reaction of lithium hydride and silicon tetrachloride and clarify the engineering economical feasibility on the subsequent target, and the result of the study was summarized by the following 4 items: (1) Monosilane generation test (2) Research on the general automatic control and the increase in efficiency. (3) Research on monosilane evaluation technology. (4) Conceptual design on production facility. On the generation facility of monosilane, it is known that a part of lithium separated on the anode - anode room wall is recombined with chlorine while another part is released from the anode room, and the electrolysis division was to be converted. And assuming an application for a commercial unit of 100 ton/year capacity it was concluded that a control system of a dispersive type based on the existing concept is most adequate. The wafer base plate is effective for the gas evaluation as much as that of 1 k-omega order while the concentration of the current is usually prevented by increasing the cross section of electrodes, and a vertical system using a monocrystal silicon rod was found to be the best. (3 tabs)

17945 (NP—8770046, pp 322-329) **Commercial application of amorphous solar cells. High-quality production technology.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This study was performed as one of researches funded by NEDO. And the study is aimed at a technology for the manufacture of an amorphous solar electric cell with good recurrence and excellent solar light sensibility serving the purpose of power generation, and is intended also to clarify the engineering economical feasibility. The content of the R and D program is divided to the following 4 items (1) Research on manufacturing technology of amorphous semi-conductor with a high quality. (2) Modulation technology research. (3) Research on electrode formation technology. (4) Research on reliability technology. On item (1), as a material excellent in sensibility for a light of the long wave length, SiGe ; H was developed, and a tandem type cell with the most promissing construction to obtain high efficiency was studied for application. And by applying radicals of a low reactivity selectively, an efficiency of 1.77% that is the maximum value in the past was obtained. On item (2) for modulation, as a result of the study on the material forming an insulating membrane, a membrane of a polyamide family material with an extremely strong adhereing property and capable of withstanding a temperature of 450°C was obtained. On item (4) for the electrode formation technology, a combination of the P layer grown under low temperature and crystallized to fine crystals, and ITO was selected. On item (4) for the reliability technology, the various stability for a-Si-Ge : H cell was studied, and a product with a deteriorating rate about a half of the existing type was obtained. (5 figs)

17946 (NP—8770046, pp 330-335) **Commercial application of amorphous solar cells. High-quality material production technology.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This study was performed as one of researches funded by NEDO. And the study is aimed at an investigation of a new material necessary to increase efficiency of an amorphous solar electric cell, and to increase a conversion rate also by improving the membrane forming system. The content of the R and D program is as follows: (1) Research on new material: To improve the quality of the membrane of a narrow band gap material consisting a solar electric cell of the multi-layer construction, and to increase the efficiency. (2) Development of an optimum cell: By examining the construction and joint boundary formation of the multi-layer solar electric cell, and improve the conversion rate. As a result of the aforesaid investigation, the following results on the research were obtained: (1) To improve the quality of the membrane of a - SiGe:H type by a glow discharge process, a study on DC base plate bias process and the hydrogen dilution was performed, and values above 10^{-5} S/cm were obtained at a region of band gap of over 1.4 eV (2) Development of an optimum cell: by an addition of Ge a narrow band gap cell with a sensitivity ranging to a long wave region of 900 nm was made and by applying it for the cell of a tandem construction, an increase in efficiency of the solar electric cell is achievable and promissing. (7 figs)

17947 (NP—8770046, pp 336-342) **Commercial application of amorphous solar cell. Development of transparent current conducting technology.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This study was performed as one of researches funded by NEDO. And the study is aimed at an improvement of efficiency and cost reduction of an amorphous solar electric cell by decreasing resistance, increasing transparency and texturalization, and increasing resistivity against plasma while making mass-production feasible. On the membrane formation, by using a normal pressure CVD unit, a current conducting glass of stannic oxide was produced to study for the decrease of resistance, increase of transparency and texturalization, and an optimum CVD condition was explored. After abrasion, a current conducting membrane of a good quality with a membrane thickness 5,600 A, sheet resistance 5.2Ω/sq. cm, specific resistance 3.2 X 10^{-4} Ω/cm, was obtained. It was found that in case when the stannic oxide only was formed on the glass base plate, and in case when a reflection prevention treatment was performad, within a region of 6,000 - 7,000 A, by means of the reflection prevention treatment, the transparency goes up reaching 83 - 84%. On the exploration of an optimum texture, it was found that by an abrasion process it is difficult to increase the ratio of the particle hight and particle diameter, and the abrasion cost will be too high, and on the plasma resistivity, the resistivity of stannic oxide was studied, and it was found that in case a-Si membrane is piled in layers, the deterioration by plasma is markedly alleviated. (4 figs, 5 tabs)

17948 (NP—8770046, pp 343-347) **Commercial application of amorphous solar cells. Large area cell production technology.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This study was performed as one of researches funded by NEDO. And the study is aimed at a development of a production technology of an amorphous solar electric cell for power generation by means of a cell with a good uniformity and having an extensive area and clarify the technical and economical feasibility. The R and D program was carried out on the following 4 items: (1) Research on a - Si membrane forming process covering an extensive area. (2) Research on low cost transparent electrode forming process covering an extensive area. (3) Research on a cell with a large area (4) Research on evaluation technology. The outline of the result of the study was as follows: (1) Using an IVE (International - Vertical - Electrode) type unit, a research on CVD process capable of forming a membrane on a base plate covering the area of 1,200 cm^2 was performed, and as a result, the Large Area a - Si Membrane Forming Technology was further advanced. (2) By means of the development of the process engineering centered on laser patterning technology, and inside electrode forming technology, and by the correction of the configuration of the tranparent current conducting membrane surface, a conversion efficiency of 11.5% was obtained by a cell with an area of 1 cm^2, and the practical efficiency of 7.5% was obtained by a cell having an area of 1,200 cm^2 (30cm X 40 cm). (4 figs)

17949 (NP—8770046, pp 348-358) **Commercial application of amorphous solar cells. High efficiency production technology.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

A research for developing a fundamental technology for manufacturing amorphous solar cell for electric power with high speed and clarifying its technical and economic possibilities. 1. Development of technology for high speed formation of amorphous film; An experimental study for improving film characteristics and cell characteristics at the time of high speed formation of film was conducted, using a mono silane gas of high dimension silane gas as a material gas. 2. Development of technology for recovering material gas; A technological development for effectively recovering undecomposed material gas discharged from a plasma reactor was carried out. 3. development of technology for formation of solar cell module with high efficiency; Evaluation and discussion on laser patterning technology for a transparent electrode and amorphous film was made. As a result of the above study, photoelectric conversion efficiency of 11.7% in terms of 1cm² element and 9.72% in terms of 10cm square IC type element was obtained. (11 figs)

17950 (NP—8770046, pp 359-371) **Commercial application of amorphous solar cells. Technology for high speed formation of amorphous film.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

A study for contriving high speed formation of amorphous film for a solar cell by developing new materials such as disilane etc. and providing an optimal manufacturing conditions. 1. Study on material for amorphous film formation with high speed and excellent performance and its evaluation technoloty; In order to attain high speed and excellent performance of amorphous film formation, development of formation method taking a decomposition mechanism of disilane into consideration, development of p-SiC using disilane as a base, improvement in properties of p/i interface by photo CVD, and enhancing of speed and performance through examination of a new solar cell structure interposing a blocking layer in position between p/i interfaces were conducted. As a result, an i layer formation speed of 3A/s and conversion efficiency of 11.0% in terms of 3mm square with disilane as a material were obtained. 2. Study on amorphous film and amorphous solar cell with high-speed and excellent performance; Optimization of plasma control and gas at the time of film formation was contrived applying the material mentioned in item 1. Especially, a automatic entrolsystem for film formation conditions was developed paying attention to the decomposition and deposition properties of disilane which is different from those of monosilane. As a result, photoelectric conversion efficiency of 10% was attained through formation of i layer at a high-speed of 20A/s. (14 figs)

17951 (NP—8770046, pp 372-384) **Commercial application of amorphous solar cells. High reliability production technology.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

A study for pursueing possibilities of solar cell with less deterioration in light irradiation and contriving establishment of accelerated degradation test by adding fluorine to an amorphous film. (1). Development of fluorine high reliability solar cell; A solar cell of simple P/i (F,H)/n structure was prepared using an i layer in which SiF_4 gas flow rate was varied to clarify suppression effect of fluorine to photodeterioration. Also it was clarified that the phenomenon of photodeterioration of an a-Si solar cell needs tp consider hydrogen content together with the effect of fluorine. Besides, a method of measuring spectral-respnse characteristics of a tandem element by separating the element into individual pins was developed. (2). Establishment of accelerated degradation test; It was clarified that the photodete riovation and the radiation strength are connected with each other in that the stronger the radiation strength is, the more the photo deterioration apt to takes place. Based of the relationship above, a menthod of converting the test data on the accelerated degradation test applying high speed light into out door exposure conditions was established to prove the accelerated degradation test is practically effective as a means of degradation predicting. (16 figs)

17952 (NP—8770046, pp 385-393) **Commercial application of amorphous solar cells. Study on clarification of degradation mechanism.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

A study for analyzing degradation mechanism of amorphous material and solar cell element with respect to physical property in order to contrive higher reliability of amorphous solar cell to acquire a fundamental knowledge for preparing a high reliability element for electric power, while providing a prototype high reliability element to conduct an evaluation on its reliability. 1. Clarification of degradation mechanism; A study on S-W effect and element characteristics under ultra high pressure was carried out so as to clarify structural factor of a-Si relating to degradation. Also, microscopic measurement of distribution of solar cell characteristics was effected applying electronic beam induction current (EBIC) for promoting a technological development to prepare the high reliability element. 2. Development of high reliability element; Based on the knowledge obtained from the high voltage experiment for clarification of degradation mechamism stated above, a preliminary experiment on preparing high quality film paying attention to behavior of hydrogen in a-Si film was executed. 3. Evaluation of reliability; Evaluation of reliability of the element was made through secular change of element characteristics by light irradiation and current inrushing and deriving of degradation coefficient by acceleration and deceleration tests. (11 figs, 1 tab)

17953 (NP—8770046, pp 394-400) **Commercial application of amorphous solar cells. Manfacturing technology for solar cells of different substrate (Ceramic substrates).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

To clarify technological and economic possibilities of diffusion application field and usage (utilizing characteristic) of a amorphous solar cell comprising dissimilar substrate, making use of the feature of the amorphous solar cell that the structural substrate of the cell is not necessarily limited to specified ones. (1). Study on ceramic substrate; In order to obtain a flat surface, a study for flattening was conducted using various grazes. However, there are still some problems in the flattening. (2). Study on film formation conditions and cell structure; An examination aiming at improvement in FF and raising of Jsc was effected in order to enhance an efficiency of photoincident cells on the p side on a ceramic substrate. (3). Examination of lower electrode; Improvement in reflectivity and texturizing by means of optimization of conditions for Ag film formation by sputtering were examined applying Ti/Ag/Ti into a lower electrode structure. AS a result, a conversion efficiency 9.95% was obtained. (12 tabs)

17954 (NP—8770046, pp 401-407) **Commercial application of amorphous solar cells. Manufacturing technology for solar cells of different substrate (Flexible substrates).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

Utilizing the characteristic of amorphous solar cell which is not limited to constructive substrate, in order to assure the technical and economical possibility of usable purposes and methodes of amorphous solar cell with substrates of different kinds, the following researches have been done. (1). Selecting 2 layers of Aluminum and Stainless steel as the basic system, by the magnetron spattering metnod and rolling method, cell substrates with lower electrode films of high reflection rate and low resistivity have been obtained. (2). As the basic system, a-Si layers have had pin construction which the fine crystallized n layers are windows and with use of CVD device have been made by rolling method and the degradation of its characteristics as solar cell is few in spite of high speed accumulation and the thickness of the p,n layers have been able to be made thin. (3). Previously screen printing insulation resin on the marked off amorphous films, with use of magnetron spattering device, tin oxide. Indium film as the transparent electrode layer with low resistivity are obtained by rolling method and laser marking off is done by scanning laser beam along the insulation resin layer and comb-shaped electrodes of sliver-conductive resin are printed and the solar cells are connected by radiating laser beam to

the above-mentioned electrode and lower electrode and melting. them. In this way maskless manufacturing method of module is established. (4). Sealing method is accomplished. Also the effects of unsteady plasma of the CVD to the a-Si layers have been assured by the model experiments. (6 figs, 5 tabs)

17955 (NP—8770046, pp 408-410) **Commercial application of amorphous solar cells. Analysis of practical usage.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

In order to grasp the aspect of domestic and foreign technique as for amorphous solar cell rapidly and precisely and to reflect and support them to the researches and developments for practical usage of amorphous solar cell for electric power, in FY 1985, investigations and researches for total evaluation and actual total evaluations have been done as follows. (1). Techniques of materials and film manufacturing; The physical properties of gap materials as for a-Si have been investigated and the research and development of layer quality and high speed manufacturing of layers have been done. (2). The technique for manufacturing process of solar cell; As for substrate material, layer thickness must be thin and surface processing is important and matching with formation of transparent electrode is necessary. As for transparent electrode, formating stationary uniform film with low cost is important. In mass production, substancially low cost production is possible if the mass production increases thousand times up. As the lithography, in the various methods, laser patterning method is indispensable for manufacturing a-Si solar cells of large area. (3). The technique for high effeceincy and its present condition; Design guide for pin solar cell, the technique of irregularizing the surface of transparent electrtodes and rear reflection electrodes, the technique of controlling boundary surface and especially photo CVD film making method have been developed domestically, and conversion efficiency more than 11 percents have been obtained. (4). The techniques for long life and stabilization; For the stabilization against the characteristic degradation for light radiation, tandem construction of solar cell have been adopted and high reliability have been obtained.

17956 (NP—8770046, pp 419-424) **Development of commercialization technology of photovoltaic power generation. Research and development of system support technology.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

With the objects of developing the necessary peripheral techniques for connecting solar cells into the electric power system and generating actual power, the following 2 items have been resolved and investigated. (1). As for the problem of connecting system with electric power system, by connecting and operating 7 small systems of 2.5 KW to the experimental distribution line, the effects which were given to the electric power quality of the distribution line were resolved and protection and safeguard methods have been investigated. The effectiveness of the suppression countermeasure to the harmonics of the inverter of harmonic PWN type, the problems of voltage variation of low and high voltage distribution lines, troubles of short circuit and grounding in high and low voltage distribution line and the problems of stopping for works etc. have been resolved. (2). As for the investigation of the adaptive system figure, by adding Pmax persuiting function to the direct current constant voltage control system of the beforementioned 7 systems and changing the operating system, the characteristic data of the power generation operation have been collected and analyzed. The reliabilities of the amorphous solar cells installed in 1983-1984 have been measured and evaluated and data have been obtained. By 2 years operation, the degradation of 25-40% have been recognized. Also the actual design of the practical small photo generating system equipped with elements detecting over and low voltage and abnormal frequency in system which is a sine wave PWM type without degradation of the quality of system electric power and detects system disorder surely, have been done. (1 fig)

17957 (SAND—87-3086C) **Crystalline photovoltaic cell technology: Present and future.** Arvizu, D.E. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 9p. (CONF-880212—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004684/JAW.

From 15. annual energy technology conference and exposition; Washington, DC, USA (17 Feb 1988).

This paper summarizes the status of crystalline cell research in the program managed by Sandia National Laboratories and sponsored by the US Department of Energy (DOE). Recent advances in high efficiency and program direction are discussed for each of the three program elements which include one-sun crystalline silicon, concentrator silicon, and concentrator III-V material cells. 13 refs., 2 figs., 1 tab.

17958 (SAND—87-7021) **Polysilicon-contacted P^+ emitters for silicon solar cell applications.** Christel, L.A. (SERA Solar Corp., Santa Clara, CA (USA)). Jan 1988. Contract AC04-76DP00789. 61p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE88005106/JAW.

A polysilicon-contact technology was investigated as a method of reducing the minority carrier recombination that occurs in boron-doped p^+ emitter structures in silicon. Two different polysilicon processes using low-pressure chemical-vapor deposition were used. Undoped polysilicon that was later doped by furnace predeposition was compared with in situ-doped polysilicon followed by diffusion. PNP transistors were used as the test structure. The emitter saturation current densities measured on devices with and without polysilicon were compared. The effect of a chemically grown oxide beneath the polysilicon was also investigated. Devices with polysilicon-contacted emitters performed marginally better than those with simple metal contacts. A barrier oxide between the polysilicon and single-crystal emitter was found to offer additional improvement. The magnitude of the emitter saturation current densities observed was not as low as that seen in n-type emitter structures. 10 refs., 13 figs., 12 tabs.

17959 (SERI/CP—211-3152) **Proceedings of the 1987 high-efficiency photovoltaic subcontractors' review meeting.** (Solar Energy Research Inst., Golden, CO (USA)). 1987. Contract AC02-83CH10093. 80p. (CONF-8705244—). NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88003354/JAW.

From High-efficiency photovoltaic subcontractors' review meeting; Golden, CO, USA (19 May 1987).

This volume contains papers dealing with areas of interest in solar cell technology. Fourteen papers are distributed in three sections: (1) solar cell development; (2) Gallium Arsenide crystal growth; and (3) fundamentals of crystal growth. The papers are indexed individually. (JDH)

17960 (SERI/SP—272-3197) **Solar Energy Technical Publications Catalog: Photovoltaics.** (Solar Energy Research Inst., Golden, CO (USA)). Sep 1987. Contract AC02-83CH10093. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001128/JAW.

This catalog represents part of an effort to provide information on publications about photovoltaic research and development activities conducted by the US Department of Energy's (DOE's) laboratories. Publications listed in this catalog include technical and research reports and special publications. This catalog is a product of the US Department of Energy's Solar Technical Information Program. The program is dedicated to providing information to scientific and industrial users in ways most convenient and useful to them. This catalog focuses on photovoltaics, and its purpose is to keep the scientific and industrial communities informed of the latest developments in federally sponsored research in this technology.

17961 (SERI/STR—211-3189) **Research on multibandgap solar cells: Final subcontract report, 1 March 1984-31 January 1987.** Cape, J.A.; Fraas, L.M.; McLeod, P.S.; Partain, L.D. (Chevron Research Co., Richmond, CA (USA); Solar Energy Research Inst., Golden, CO (USA)). Jul 1987. Contract AC02-83CH10093. 91p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE87012261/JAW.

This report describes research in multibandgap solar cells. In early work, two-color solar cells with efficiencies exceeding 20% were grown monolithically, comprising a GaAsP top junction over a GaAs or GaAsSb bottom junction. Researchers attempted to understand the effects of lattice mismatch and optimize growth condi-

tions for these structures. Severe unreproducibility was encountered and traced to source material impurities. CP_2Mg, the p-dopant, was found to be undependable, and efforts were made to purify it. Impurity effects were also traced to the arsine (predominantly water vapor) and the gallium alkyls. Efforts were also made to purify these. Work focused on optimizing component cells of GaAsP and GaAsSb and on developing the growth process. This, though, did not lead to higher efficiencies. In developing component cells, work was also done on optimizing vacuum chemical epitaxy growth conditions (temperatures, flow rates, III-V ratios, chamber designs, etc.); on developing cell transition layers and reducing lattice-mismatch effects; on improving cell processing; on reducing impurities; and on improving material and cell characterization. 13 refs., 50 figs., 2 tabs.

17962 **(SERI/STR—211-3217) CdZnTe as a wide-bandgap absorber for a tandem, thin-film solar cell: Final subcontract report, 1 April 1986-31 August 1987.** Zanio, K.R. (Ford Aerospace and Communications Corp., Newport Beach, CA (USA)). Oct 1987. Contract AC02-83CH10093. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001114/JAW.

The objective of this program was to prepare by low-cost ultra-high-vacuum (uhv) methods on all-thin-film (approximately 1.6 eV) wide-bandgap solar cell using CdZnTe as the absorber layer. ZnTe/CdZnTe/n-CdS/ITO/glass structures were prepared by congruent evaporation in uhv. Ohmic contact to the ZnTe with HgZnTe and conversion of the high-resistivity ZnTe and CdZnTe was simultaneously undertaken by the closed-space vapor deposition of HgZnTe. Mesa structures did not show blocking action. Single-crystal cells were prepared by the deposition of CdS on bulk p-CdTe and thin-film, single-crystal p-CdTe-on-sapphire and p-CdZnTe-on-sapphire. A comparison of results suggests that the all-thin-film polycrystalline structure is limited by the CdZnTe. 6 refs., 4 figs., 1 tab.

17963 **(SERI/STR—211-3224) Research on single-crystal CdTe solar cells: Final subcontract report, 1 February 1985-1 February 1987.** Borrego, J.M.; Ghandhi, S.K. (Rensselaer Polytechnic Inst., Troy, NY (USA)). Oct 1987. Contract AC02-83CH10093. 100p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88001115/JAW.

This report outlines two years of work on the growth and characterization of single-crystal CdTe layers, to explore their potential for high-efficiency solar cells. It was demonstrated that high-quality layers can be grown by organometallic vapor phase epitaxy (OMVPE), whose photoluminescence peak has a FWHM of 5.8 MeV, the lowest value for them yet achieved. CdTe layers were extrinsically doped both n- and p-type with indium and arsenic, respectively. The doping level achieved for p-type is the highest yet reported in the literature, achieved for the first time in an OMVPE system. A hole lifetime of 2.0 μm was measured. In the n-type material, five deep levels were isolated; their capture cross section, energy level, and concentration were determined. A thermodynamic analysis was made to identify their defect character. Both Schottky and p-n junction devices were produced on these layers. The diode characteristics were superior to those of GaAs so this is a potentially superior material for solar cells. 14 refs., 3 figs., 2 tabs.

17964 **(SERI/STR—211-3229) Thin-film cadium telluride solar cells: Annual subcontract report, 1 May 1986-31 May 1987.** Chu, T.L. (Southern Methodist Univ., Dallas, TX (USA)). Oct 1987. Contract AC02-83CH10093. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001107/JAW.

Cadmium telluride, with a room-temperature band-gap energy of 1.5 eV, is a promising thin-film photovoltaic material. The major objective of this research has been to demonstrate thin-film CdTe heterojunction solar cells with a total area greater than 1 cm^2 and photovoltaic efficiencies of 13% or more. Thin-film p-CdTe/CdS/SnO_2:F/glass solar cells with an AM1.5 efficiency of 10.5% have been reported previously. This report contains results of work done on (1) the deposition, resistivity control, and characterization of p-CdTe films by the close-spaced sublimation process; (2) the deposition of large-band-gap window materials; (3) the electrical properties of CdS/CdTe heterojunctions; (4) the formation of stable, reproducible, ohmic contacts (such as p-HgTe) to p-CdTe; and (5) the preparation and evaluation of heterojunction solar cells. 16 refs., 19 figs., 1 tab.

17965 **(SERI/STR—211-3230) Cadmium sulfide/copper ternary heterojunction cell research: Final subcontract report, 1 October 1984-31 May 1987.** Devaney, W.E.; Mickelsen, R.A.; Chen, W.S.; Stanbery, B.J.; Stewart, J.M.; Lytle, F.W.; Burnett, A.F. (Boeing Co., Seattle, WA (USA). High Technology Center). Nov 1987. Contract AC02-83CH10093. 130p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88001122/JAW.

This is the final technical progress report on a thirty-two month research program on $CuInSe_2$ and $CuInGaSe_2$ based thin-film polycrystalline heterojunction solar cells. $CuInGaSe_2$ films incorporating Ga fractions (x in CuIn/sub 1-x/Ga/sub x/Se_2) from 0.04 to 1.0 have been prepared and characterized. $CuInGaSe_2$/CdZnS heterojunction devices have been fabricated for a range of Ga contents and show the expected variations in Voc and spectral response with Ga content. An efficiency of 10.2% (SERI test, ASTM87) has been measured for a cell with Ga fraction of 0.23, the highest efficiency reported for this material. A $CuInSe_2$/CdZnS monolithically interconnected four cell series string of 91 cm^2 area has been fabricated with a total area efficiency of 9.5% (SERI test, ASTM87). Results are presented on Ion-Assisted Deposition of the selenide and sulfide, on a new design for the Se evaporation source, on ITO reactive sputter deposition, and on CdZnS films prepared from an E-Gun Evaporation source. Spectral response and I-V characteristic variations with selenide composition before and after heat-treatment are discussed for the $CuInSe_2$/CdZnS devices. The highest AM1 total area efficiency for the $CuInSe_2$/CdZnS cell is now 11.9% (Boeing test, AM1 spectrum) with five cells measured over the previously reported high of 10.9%. Room Temperature Photoluminescence, Voltage Contrast Imaging of junction cross sections, Raman spectroscopy, and EXAFS measurements on the $CuInSe_2$/CdZnS devices are also presented and discussed. 45 refs., 41 figs.

17966 **(SERI/STR—211-3231) Research on high-efficiency, stacked, multijunction, amorphous silicon alloy thin-film solar cells: Final subcontract report, 11 October 1983-30 October 1986.** Bragagnolo, J. (Spire Corp., Bedford, MA (USA)). Oct 1987. Contract AC02-83CH10093. 125p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88001108/JAW.

This report covers the third year of a three-year project to develop high-efficiency, stable, multijunction amorphous silicon alloy solar cells. It describes new deposition techniques to obtain pinhole-free, a-Si:H alloy films by avoiding dust formation in the plasma; the deposition of low-absorptance, textured SnO_2 layers by thermal CVD of $Sn(CH_3)_4$; a more stable, high-reflectance Ti/Ag back contact; the application of the new deposition techniques to achieve efficiencies of 10.5%, 10.1%, and 9.4% for a-Si:H p-i-n devices; the development of a-(Si,Ge):H cells with efficiencies from 5.4% for a-(Si,Ge):H cells to 7.5% for graded-bandgap cells; and the development of a-Si/a-(Si,Ge) tandem cells with 6.5% and 7.2% efficiencies. 18 refs., 60 figs., 49 tabs.

17967 **(SERI/STR—211-3249) Stable, high-efficiency, $CuInSe_2$-based, polycrystalline, thin-film tandem solar cells: Final subcontract report, 16 March 1984-15 March 1987.** Birkmire, R.W.; Phillips, J.E. (Delaware Univ., Newark (USA). Inst. of Energy Conversion). Oct 1987. Contract AC02-83CH10093. 124p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88001116/JAW.

The long-term objective of this research was to obtain a stable, thin-film solar cell based on polycrystalline materials with an efficiency of 15%. The approach was to make a tandem cell based on $CuInSe_2$/CdS as the bottom cell and CdTe/CdS as the top cell. An essential feature was to develop a CdTe cell with transport contacts. A suitable contacting system was developed using transparent conducting oxides (ITO and SnO_2) in conjunction with a thin layer of copper. Cells were made with efficiencies over 8.5%. A reproducible fabrication process for $CuInSe_2$/(CdZn)S cells was developed based on $CuInSe_2$ films grown by vacuum evaporation using

Knudsen-type effusion sources. These cells were made with efficiencies over 10%. The composition of the $CuInSe_2$ films can be varied over a considerable range and still yield high-efficiency cells. Adding Zn to the CdS did not increase the V/sub oc/ of the devices; analysis showed that the V/sub oc/ is not controlled by interface recombination. The effect of oxidizing and reducing heat treatments on $CuInSe_2$ cells is to change carrier concentration and thus V/sub oc/. Analysis suggests that J/sub o/ is controlled by band-to-band recombination. Monolithic tandem $CuInSe_2$ CdTe cells have been made with efficiencies of ~3%, demonstrating the feasibility of this approach. 33 refs., 36 figs., 37 tabs.

17968 **(SERI/STR—211-3256) Investigations of the origins of metastable, light-induced changes in hydrogenated amorphous silicon: Annual subcontract report, 1 February 1986-28 February 1987.** Cohen, J.D. (Oregon Univ., Eugene (USA). Dept. of Physics). Oct 1987. Contract AC02-83CH10093. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001117/JAW.

This report presents results of an investigation into the metastable changes in the density of deep mobility gap states in hydrogenated amorphous silicon, using a variety of junction capacitance techniques. This work extends previous studies (using drive-level capacitance profiling) to some new samples. With these measurements, researchers examined how the distribution of occupied gap states changes with light soaking and partial annealing through a series of intermediate states between states A and B. The results on two phosphorus-free samples indicate no qualitative change from previous results, which revealed a large metastable increase in the concentration of D^- centers with light soaking, so phosphorus contamination is not crucial to this increase. Because such an increase is inconsistent with the Si-Si bond-breaking model, this result favors a model in which local configurational changes shift the gap-state energies of existing defects. Transient photocapacitance was applied to undoped films to investigate metastable changes in more detail. Results seemed to confirm the magnitude of the metastable defect creation found by drive-level analysis on the same samples. 14 refs., 11 figs., 2 tabs.

17969 **(SERI/TP—211-3272) SERI's Photovoltaic R and D Project: Recent progress and future directions.** Surek, T. (Solar Energy Research Inst., Golden, CO (USA)). Nov 1987. Contract AC02-83CH10093. 14p. (CONF-8711127—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001129/JAW.

From Special meeting of the Kansai Section of the Japan Solar Energy Society and the Japan Applied Physics Society; Osaka, Japan (10 Nov 1987).

Photovoltaic (PV) research efforts at the Solar Energy Research Institute (SERI) focus on developing improved generations of photovoltaic technologies having the potential for low cost, high performance, and long-term reliability. The new PV technology generations are thin-film single-junction and multijunction devices suitable for either flat-plate or concentrator systems, and advanced crystalling silicon sheet materials. Improvements in materials and processing, solar cell design, and cell fabrication techniques have led to remarkable progress for these new generations of photovoltaic devices leading to record cell efficiencies in nearly all material areas. Current research identified the criticality of source material purity and the device processing conditions for a number of different PV materials. Furthermore, attention to total device design and processing helped to realize greater understanding of metallic contacts, transparent conductors, and interlayers. The development of sophisticated models enabled quick assessment of device concepts. Another characteristic of current research directions is increased collaboration among PV experts. Enhanced measurement and characterization techniques, along with interaction among PV scientists, are adding to a strong scientific foundation for the photovoltaic future. 2 refs., 9 figs., 3 tabs.

17970 **Deposition and etching of a-Si:H:F using silane and xenon difluoride.** Tsuo, S.; Weil, R.; Asher, S.; Nelson, A.; Xu, Y.; Tsu, R. (Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO). pp 705-708 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—). Contract AC02-83CH10093.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

The authors developed a novel fluorination method for a-Si:H by using a mixture of silane (SiH/sub 4/) and xenon difluoride (XeF/sub 2/) as feed gas in radio frequency glow-discharge deposition. They found, using a residual gas analyzer, that SiH/sub 4/ reacts rapidly and spontaneously with XeF/sub 2/ at room temperature. By using a novel technique of periodically varying the silane partial pressure of the SiH/sub 4/-XeF/sub 2/ process gas mixture, they deposited high-quality a-Si:H:F films with up to about 6 at .% fluorine content.

17971 **Radiation damage of 1.93-eV Al/sub 0.37/Ga/sub 0.63/As and GaAs solar cells grown by metalorganic chemical vapor deposition.** Hamaker, H.C.; Werthen, J.G.; Lewis, C.R.; MacMillan, H.F.; Ford, C.W.; Virshup, G.F.; Ahrenkiel, R.K.; Greenberg, D.L.; Schlupmann, J. (Varian Research Center, Palo Alto, CA 94303). pp 733-737 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

The effects of radiation upon the solar cell performance of GaAs and 1.93-eV Al/sub 0.37/Ga/sub 0.63/As have been examined. GaAs cells having beginning-of-life efficiencies in excess of 20% (one-sun, AMO) in both the n-p and p-n configurations have been exposed to 1-MeV electrons. The p-n configuration showed better radiation tolerance than the n-p. The 1.93-eV Al/sub 0.37/Ga/sub 0.63/As material was studied both in n-p solar cells and in time-of-flight (TOF) samples, from which fundamental material parameters could be determined. The Al/sub 0.37/Ga/sub 0.63/As cells showed better radiation tolerance than their GaAs counterparts, and the diffusion length damage coefficient κ/sub L/ was measured to be —10/sup -8/. The observed damage cannot be satisfactorily explained using a model based solely upon the decrease in the bulk minority carrier lifetime. The effects of proton irradiation on the Al/sub 0.37/Ga/sub 0.63/As cells are also presented.

17972 **Rapid characterization of photovoltaic materials using photoelectrochemical techniques.** Kurtz, S.R.; Olson, J.M. (Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO 80401). pp 823 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

The development of a new materials technology for photovoltaic devices is often hindered by the lack of a rapid quantitative technique for measuring the photovoltaic quality of the new material as a function of growth parameters, doping levels and device processing procedures. Photoelectrochemical methods are shown to provide rapid quantitative characterization without the limitations of photoluminescence and other techniques. The short circuit photoelectrochemical current is shown to be proportional to the short circuit current of a solid state photovoltaic device made from the same material. Electrolyte-semiconductor junctions are also used to measure the band gap, carrier concentration and diffusion length.

17973 **The electron collection efficiency of a-Si,Ge:H,F at 300K to 400K.** Shen, D.S.; Conde, J.; Alijishi, S.; Smith, Z.; Chu, V.; Kolodzey, J.; Wagner, S. (Dept. of Electrical Engineering, Princeton Univ., Princeton, NJ 08544). pp 884-888 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

The authors report the electron drift mobility μ, μtau product and charge collection efficiency of a-Si,Ge:H,F alloys (1.28eV $\leqq$E/sub g/ $\leqq$ 1.58eV) measured by the time-of-flight technique. The conduction band tail becomes about twice as wide (kT/sub c/ $\approx$50meV) as in un-alloyed a-Si:H,F as soon as Ge is introduced. In addition, a peak exists in the tail state density — 0.4 eV below the mobility edge. This peak is related to Ge, but its density scatters

widely between samples and reflects alloy quality. μ and μtau rise sharply with T and suggest a high working T for a-Si,Ge:H,F based solar cells.

17974 **Production efficiency goals for silicon solar cells.** Basore, P.A. (Sandia National Labs., Albuquerque, NM 87185-5800). pp 905-911 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Solar cells that can cost-effectively implement recent advances in laboratory cells are described and their potential performance evaluated as a function of cell thickness and carrier lifetime. Bifacially-contacted concentrator cells designed for 100-suns illumination (10 W/cm/sup 2/) appear to be capable of reaching 30% efficiency using either a high- or low-resistivity base about 100 μm thick. One-sun cells that are subject to additional cost constraints have a peak efficiency of about 21% using either a high- or low-resistivity base about 50 μm thick. Even modest-quality material is capable of high efficiency when the cells are this thin.

17975 **Analysis of CuInSe/sub 2/: Electron and ion beam effects.** Kazmerski, L.L.; Burnham, N.A.; Swartzlander, A.B.; Nelson, A.J.; Asher, S.E. (Solar Energy Research Institute, Golden, CO 80401). pp 1315-1321 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

The effects of electron and ion beams used in the analysis of CuInSe/sub 2/ surfaces are examined. Potential changes in the surface chemistry - including oxidation, desorption and preferential species removal - under a range of incident probe conditions, are investigated for possible artifactural information generation. Emphasis is placed on the relationships between beam conditions and oxygen chemisorption and physisorption, since oxygen treatments of devices utilizing this semiconductor are critical to performance. Single crystals and polycrystalline thin films are analyzed and compared to establish the beam-induced phenomena.

17976 **The effect of composition on the optical properties of CuInSe/sub 2/ thin films.** Tuttle, J.R.; Noufi, R.; Dhere, R.H. (Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO 80401). pp 1494-1495 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—). Contract AC02-83CH10093.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

The absorption coefficient and band gap for CuInSe/sub 2/ thin-films are derived from transmission and reflection data in the near infrared (NIR) spectrum, 2000 nm to 740 nm, and are determined to be in the range 2-6x10/sup 4/ cm/sup -1/ and .94-1.02 eV, respectively. Measurements are made for several film compositions ranging from 18.7 at .% to 26.0 at .% Cu, with Se/metal ratio of about 1.0. A mild dependency of α and energy-gap on composition is observed.

17977 **Quality of CuInSe/sub 2/ and CdS thin films for solar cells.** Dhere, N.G.; Ribas, P.R.F.; Moutinho, H.R.; Swartzlander, A.B.; Asher, S.E.; Goral, J.P.; Kazmerski, L.L. (Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO 80401). pp 1498-1499 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Stoichiometric p-type, CuInSe/sub 2/ thin films have been high vacuum deposited on heated substrates, by co-evaporating to completion proportional quantities of Cu and In, in the presence of excess Se vapours. It was found that unannealed Cu- and In-rich layers deposited respectively at 350° and 400°C are inhomogeneous; and that the films can be made homogeneous by depositing and subsequently annealing the In-rich layer at 420°C for 5.5 min. CdS thin films deposited using the hot wall technique on substrates heated to 190°C, with an air leak total pressures of 5-7x10/sup 6/ showed hillock growth and considerable oxygen incorporation.

17978 **Reliability research and cell assembly design for photovoltaic concentrator modules.** Chiang, C.J.; Richards, E.H. (Photovoltaic Technology Div. 6221, Sandia National Labs., Albuquerque, NM 87185). pp 1222-1227 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Sandia National Labortories is pursuing research on the reliability of photovoltaic concentrator cell assemblies. Active research topics include selection of solders and soldering processes, modeling of solder fatigue, investigation of metallization adhesion, evaluation of adhesives and coatings, and analysis of hotspot heating and the effects of module shading. Hardware and material samples are subjected to test environments including temperature and humidity cycling, and ultraviolet and outdoor exposure. Evaluation techniques used to detect flaws or degradation are electrical performance measurements, ultrasonic imaging, radiography, optical transmission and reflection measurements, pull tests, and current leakage measurements. Analysis tools are failure modeling, holographic deformation visualization, and finite element stress calculation. The procedures and results of our reliability research concerning cell assemblies are described. The authors present ideas for the design of cell assemblies for high efficiency, low cost, and enhanced reliability.

17979 **Qualification testing of photovoltaic concentrators.** Richards, E.H.; Barlow, R.S. (Sandia National Labs., Albuquerque, NM 87185). pp 1228-1233 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Sandia has developed a revised set of specifications for qualification testing of passively-cooled photovoltaic concentrator modules. The purpose of the tests is to screen new concentrator designs and new production runs for susceptibility to known failure mechanisms; concentrator hardware must be qualified prior to array-level installation at Sandia's Photovoltaic Advanced System Test Facility (PASTF). Tests for cell assemblies and receiver sections, as well as for complete modules, are specified. They include ultraviolet radiation testing of materials, characterization of electrical performance, checks to assure safety and structural integrity of modules, and accelerated environmental aging or cycling.

17980 **Rapid isothermal processing of bulk and thin film solar cells.** Singh, R.; Radpour, F.; Anandakugan, S.; Chou, P.; Ullal, H.S.; Asher, S.; Kazmerski, L.L. (School of Electrical Engineering and Computer Science, Univ. of Oklahoma, Norman, OK 73019). pp 1279-1284 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Rapid isothermal processing (RIP) based on incoherent light sources is a promising technology for the fabrication of solar cells. The authors used RIP for the homojunction formation in bulk InP and CdTe and CuInSe/sub 2/ thin films. Shallow and sharp junctions have been obtained by this process resulting into higher open circuit voltage. In this paper the authors present our bulk InP, CdTe and CuInSe/sub 2/ thin film solar cells results.

17981 **The DOE/SERI polycrystalline thin-film solar cell program.** Zweibel, K.; Ullal, H.; Mitchell, R. (Solar Electric Conversion Research Div., Solar Energy Research Institute, 1617 Cole Boulevard, Golden, CO 80401). pp 1322-1328 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—). Contract AC02-83CH10093.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

The Photovoltaic Program Branch's Polycrystalline Thin Film Task oversees subcontracted work in copper indium diselenide (CuInSe/sub 2/) and cadmium telluride (CdTe) technologies. Devices produced from these materials have strong potential in photovoltaics because of their low cost, reasonable efficiency, and stability. Some of the major recent accomplishments of the program were (1) the achievement of 10.5% efficiency with a CdTe device, (2) an improvement in the efficiency of selenized CuInSe/sub 2/ cells to nearly 8%, (3) the development of a transparent contact to CdTe cells for possible use in the top cell of a tandem structure, (4) the achievement of a 10.2% Cu(Ga,In)Se/sub 2/ cell; and (5) the fabrication of a 9.6% efficient 91-cm/sup 2/ CuInSe/sub 2/ submodule. This paper also presents directions and plans for future work.

17982 **Interpretation of an oxidation/reduction experiment on high efficiency CuInSe/sub 2//CdS devices.** Damaskinos, S.; Meakin, J.D.; Phillips, J.E. (Institute of Energy Conversion, Univ. of Delaware, Newark, DE 19716). pp 1299-1304 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

The influence of oxidation (air) and reduction (hydrogen) heat treatment cycles on the performance of high efficiency CuInSe/sub 2//CdS devices and the resistivity of the CuInSe/sub 2/ films have been investigated. Device measurements have included current-voltage as a function of temperature and light intensity. It is shown that device behavior can be interpreted in terms of the observed changes in CuInSe/sub 2/ resistivity that result from oxidation/reduction treatments.

17983 **Corrosion of a-Si cells and modules.** Mon, G.R.; Wen, L.; Ross, R.G. Jr. (JPL, Pasadena, CA). pp 1090-1094 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

This paper reports on corrosion/erosion phenomena observed in exposing a-Si cells, modules, and specially designed test structures to natural and accelerated test environments. Relevant cell and module I-V curve data, monitoring degradation, are presented. The causes of observed degradations, methods of mitigation, and consequences for fielded modules are discussed.

17984 **Characterization of the Isc versus irradiance relationship for silicon and III-V concentrator cells.** Gee, J.M. (Photovoltaic Cell Research Div., Sandia National Labs., Albuquerque, NM 87185). pp 1390-1395 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

The authors measured the responsivity (which is defined as the short-circuit current divided by the irradiance) of silicon and III-V concentrator cells for irradiances up to 1000X. The silicon cells have various resistivities and thicknesses and have both planar and non-planar junction geometries. They investigated high-resistivity silicon cells since future advanced silicon concentrator cells will probably use high-resistivity material. Substantial sublinearities of Isc versus irradiance were found in all the high-resistivity (>1 Ωcm) silicon cells that the authors evaluated. In contrast, the III-V concentrator cells (InGaAs and GaAs) were both found to be linear up to 1000X.

17985 **Recent achievements in module reliability research.** Ross, R.G. Jr. (Jet Propulsion Lab., California Institute of Technology, Pasadena, CA 91109). pp 993-1000 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

After 10 years of extensive research on crystalline-silicon flat-plate photovoltaic modules, the emphasis of recent reliability research has shifted to the emerging first-generation thin-film amorphous-silicon modules. These new modules share much in common with their crystalline precursors, but also include many new materials and processes that demand the development of new reliability technologies. Key research thrusts include light induced effects, cell corrosion, thermal diffusion, hot-spot heating, and electrical isolation of the cells from the module exterior. Research goals and recent achievements are described in each of these areas.

17986 **Soft x-ray photoemission investigation of the oxidation of CuInSe/sub 2/ thin films.** Zurcher, P.; Nelson, A.J.; Johnson, P.; Lapeyre, G.J.; Noufi, R. (Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO 80401). pp 955-960 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—). Contract AC02-83CH10093.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

CuInSe/sub 2/ films are used as absorber layers in heterojunction thin film solar cells. It has been demonstrated that, depending on the stoichiometry, oxygen annealing can make CuInSe/sub 2/ films more p-type or even convert n-type films into p-type while subsequent reduction with hydrazine will reverse such processes. Using synchrotron radiation soft x-ray photoemission spectroscopy, the authors found associated with the hydrazine reduced films an In1+ state that converts into In3+ under the influence of oxygen at elevated sample temperatures. The samples investigated were grown in a way that the top several thousand Angstroms are increasingly Cu-poor and In-rich. It is this region which is sampled by the surface sensitive technique of photoemission. The Cu-poor/In-rich top regions will most likely have a large number of intrinsic In on Cu-site defects leaving the In in a 1+ state. All the oxidation and reduction results and the associated changes in majority carrier concentrations and type conversions can be understood in terms of oxygem/In/sub Cu/-defect interactions.

17987 **Open-circuit voltage decay as a measure of a-Si stability.** Longrigg, P.; Berry, W.B. (Solar Energy Research Institute, Golden, CO 80401). pp 1488-1489 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—). Contract AC02-83CH10093.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Open-circuit voltage decay, OCVD, has long been considered an effective nondestructive technique for determining carrier lifetime in fabricated p-n junction devices. Initial studies were directed toward understanding recombination and the participating processes, but provided the background for understanding voltage decay. Later work extended this to three-layer p-i-n and p-L-n structures. More recently, others reviewed the established theory and surveyed various responses expected from solar cells and submodules. Their conclusion was that OCVD provides a much better estimate of the real lifetime than injection decay. The purpose of this work is to point out that this measurement continues to be of value in the study of solar cell aging, stability, or degradation with time and environment (e.g., in the case of amorphous silicon cells, with exposure to light). There are three basic ideal OCVD response regimes from which lifetime can be quantified. The response for two of these regimes is linear, and the lifetime is inversely proportional to the slope of the OCVD response. The constant of proportionality is two for a generated carrier concentration, n/sub g/, greater than the majority concentration, n/sub Q/, and unity for n/sub o/ >n/sub g/ >p/sub o/, the minority concentration. The ex-

ponential third region reflects nonlinear behavior and junction effects.

17988 **26.1% solar cell efficiency for GaAs mechanically stacked on Ge.** Partain, L.D.; Kuryla, M.S.; Weiss, R.E.; Werthen, J.G.; Virshup, C.F.; MacMillan, H.F.; Hamaker, H.C.; King, D.L. (Chevron Research Co., Richmond, CA 94802). pp 1504-1505 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

A combined efficiency of 26.1% was measured with a GaAs cell mechanically stacked on top of a Ge cell in 285X concentrated, air mass 1.5 direct normal (AM1.5D) sunlight. The equivalent air mass zero (AMO) efficiency is 23.4% at a 159X concentration. Modified substrate doping should increase this performance. Mechanical stacks allow high efficiency, two junction solar cells to be made in the near term. They avoid the direct contact growth of differing materials with interfering growth conditions. With four external contacts, they eliminate the need for internal shorting junctions and current matching. These factors greatly improve device fabrication yields. And the voltage matched configuration allows well developed GaAs or Si to be used for one of the two junctions. The main requirement for high performance is for the junction band gaps to differ by 0.4 to 0.8 eV. This identified GaAs on Ge as a promising pair for mechanical stacking with respective band gaps of 1.41 and 0.67 eV.

17989 **CuInSe/sub 2//ZnSe solar cells using reactively sputter-deposited ZnSe.** Nouhi, A.; Stirn, R.J.; Hermann, A. (Jet Propulsion Lab., California Institute of Technology, Pasadena, CA 91109). pp 1461-1465 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

This paper presents preliminary results on CuInSe/sub 2// ZnSe thin film heterojunction photovoltaic devices. By the use of reactive magnetron co-sputtering of Zn and In dopant in Ar/H/sub 2/Se, ZnSe thin films have been deposited on glass and conducting SnO/sub 2/-coated glass substrates with resistivity as low as 20 ohm-cm at deposition temperatures as low as 120°C. Preliminary ZnSe depositions onto CuInSe/sub 2/ films supplied by industrial laboratories are very encouraging. Reactive sputter deposition parameters for ZnSe have yet to be optimized for CuInSe/sub 2/ substrates. However, for ZnSe films on ARCO Solar-supplied CuInSe/ sub 2/, open-circuit voltages as high as 430 mV were obtained. The highest short-circuit current density, as determined by spectral response weighted for AM1.5 global insulation, was 37.4 mA/cm/sup 2/. In all cases, a highly conductive ZnO film was overcoated onto the ZnSe at ARCO Solar, Inc. to reduce the overall sheet resistance. A more recent series of depositions varying Zn to Se content were inconclusive.

17990 **Flat-plate PV array performance comparison of four different tracking modes.** Freen, P.D.; Marion, B.; Healey, H. (Florida Solar Energy Center, 300 State Road 401, Cape Canaveral, FL 32920). pp 1252-1256 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

The Florida Solar Energy Center (FSEC) in Cape Canaveral, Florida has operated a tracking photovoltaic research facility since March 1985. Since it began operation, this facility has ben used to test and compare, on a side-by-side basis, four matched 500 peak Watt (W/sub p/) photovoltaic systems operating in the following four tracking modes: two-axis, single-axis "SMUD" type (i.e., rotation about a fixed north-south axis), single-axis azimuth tracking (i.e., rotation about a vertical axis at fixed latitude tilt) and fixed orientation (south facing at latitude tilt). This paper presents measured and predicted performance of the four tracking arrays for one year (March 21, 1985 to March 20, 1986).

17991 **Review of research on polycrystalline silicon solar cells.** Milstein, J.B.; Tsuo, Y.S. (Solar Electric Conversion Research Div., Solar Energy Research Institute, Golden, CO 80401). pp 115-120 of Photovoltaics for solar energy applications II. Adler, D. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1983). (CONF-830420—).

From Society of Photo-Optical Instrumentation Engineers conference; Arlington, VA, USA (4 Apr 1983).

This paper reviews recent results obtained in the polycrystalline silicon solar cell task area at the Solar Energy Research Institute (SERI) and presents a description of the goals which are expected to be achieved in the next year and beyond.

17992 **(BNL—40539) Theoretical models of electrochromic and environmental effects on bacterio-chlorophylls and -pheophytins in reaction centers.** Hanson, L.K.; Thompson, M.A.; Zerner, M.C.; Fajer, J. (Brookhaven National Lab., Upton, NY (USA); Florida Univ., Gainesville (USA)). 1987. Contract AC02-76CH00016. 14p. (CONF-8709222—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004441/JAW.

From NATO advanced research workshop on structure of bacterial reaction centers: X-ray crystallography and optical spectroscopy with polarized light; Cadarache, France (20 Sep 1987).

The primary charge separation in photosynthetic reaction centers (RC) is carried out by an array of (bacterio)chlorophylls arranged in close proximity. The recent x-ray structures of the RC complexes from Rhodopseudomonas viridis and Rhodobacter sphaeroides reveal two possible electron pathways for purple bacteria, only one of which is active. We have calculated the effects of hydrogen bonding and chemical modification (enolization) by nearby residues upon the optical spectra, reduction potentials, unpaired spin density distributions and charge densities of bacteriochlorophylls (BChl) and -pheophytins (BPh). In addition, we have calculated the effect of generating the primary cation and anion products on the spectra of the accessory BChl and BPh pigments in the RC. At the present levels of refinement, x-ray structures of Rb. sphaerides, which contains BChls a, reveal a molecular architecture analogous to that of R. viridis, which is comprised of BChls b. Similar electrochromic shifts are thus predicted for the two species. 28 refs., 4 figs., 4 tabs.

17993 **(DOE/ER/13265—T1) [Genetic engineering of corn and other higher plants]: Final technical report.** Davis, R.W. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). 1987. Contract FG03-84ER13265. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004497/JAW.

Two uses for restriction fragment length polymorphisms associated with multigene families in the corn genome were demonstrated. RFLPs detected by a DNA probe (cZm7) homologous to a multigene family of unidentified function were used as genetic markers for the identification of inbred lines. A rapid small-scale procedure was presented for isolating DNA from individual corn seedlings suitable for digestion by restriction endonucleases. When hybridized to inbred line DNAs digested with a single restriction enzyme, the cZm7 probe detects unique patterns in 47 out of 49 (96%) inbred lines widely used in corn breedings. Linkage analysis of RFLPs associated with a second multigene family was used to determine the genomic organization of the gene family. Methods were outlined for identifying alleles of loci belonging to multigene families that were polymorphic by analyzing the DNAs of a relatively small number of F_2 segregants. These approaches were generally useful for the genetic analysis of multigene families in diploid organisms for which a DNA probe and individuals exhibiting RFLPs detected by the probe were available.

17994 **(EUR—11048) Squeezing of pre-pressed beet pulp after extraction using a specially designed secondary press in order to save energy for drying by the application of heat: Demonstration project, Final report.** Jacobiak, G. (Nordharzer Zucker AG, Schladen (Germany, F.R.)). 1987. 28p. (In English and German). NTIS (US Sales Only), PC A03/ MF A01. Order Number DE88900313/JAW.

A by-product of sugar production from sugar beet is beet pulp, which is processed to animal feed by mechanical pressing and heat-drying. The cost of mechanical pressing is considerably lower than the drying cost. The aim of this study was to demonstrate a machine to press the squeezed pulp a second time and thus raise the dry matter content. The machine is a horizontal twin-screw press, type HP 2000 from Messrs. Selwig und Lange in Braunschweig. It was designed to press the equivalent of 1800 tons of beet per day, raising the initial dry matter content from 19% to 26%. The throughput of the press is inadequate for today's requirements. Thorough pressing performance requires such a drop in throughput that a factory would require a large number of presses. The two-stage pressing procedure therefore does not appear justified in view of the greater technical effort required, when identical results can be obtained with a single press. 5 figs., 2 tabs.

17995 **(FRNC-CONF—245) Seminar on biogas.** (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). Nov 1984. 194p. (In French). (CONF-8411316—). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88751080/JAW.

From Seminar on biogas; Saint-Remy-les-Chevreuse, France (15 Nov 1984).

The 35 communications of the 1984 biogas seminar organized by AFME are presented: research and development on fermentation and biogas processes of agricultural wastes (livestock and poultry manure, straw,..), purification and on site utilization of biogas, technical and economical analysis of the manure fermentation processes (models, experimental evaluation, collective operations), optimization of the biological and chemical reactions involved in waste fermentation, biogas from agriculture and food industry wastes and from municipal wastes.

17996 **(LBL—24352) Triterpenoid biosynthesis in Euphorbia lathyris latex.** Hawkins, D.R. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 104p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005478/JAW.

The structures of triterpenols, not previously been known, from Euphorbia lathyris latex are reported. A method for quantifying very small amounts of these compounds was developed. Concerning the biochemistry of the latex, no exogenous cofactors were required for the biosynthesis and the addition of compounds such as NADPAH and ATP do not stimulate the biosynthesis. The addition of DTE or a similar anti-oxidant was found to help reduce the oxidation of the latex, thus increasing the length of time that the latex remains active. The requirement of a divalent cation and the preference for Mn in the pellet was observed. The effect of several inhibitors on the biosynthesis of the triterpenoids was examined. Mevinolin was found to inhibit the biosynthesis of the triterpenoids from acetate, but not mevalonate. A dixon plot of the inhibition of acetate incorporation showed an I_{50} concentration of 3.2 μM. Fenpropimorph was found to have little or no effect on the biosynthesis. Tridemorph was found to inhibit the biosynthesis of all of the triterpenoids with an I_{50} of 4 μM. It was also observed that the cyclopropyl containing triterpenols, cycloartenol and 24-methylenecycloartenol were inhibited much more strongly than those containing an 8-9 double bond, lanosterol and 24-methylenelanosterol. The evidence indicates, but does not definetely prove, that lanosterol and 24-methylenelanosterol are not made from cycloartenol and 24-methylenecycloartenol via a ring-opening enzyme such as cycloeucalenol-obtusifoliol isomerase. The possibilty that cycloartenol is made via lanosterol was investigated by synthesizing 4-R-4-^{3}H-mevalonic acid and incubating latex with a mixture of this and ^{14}C-mevalonic acid. From the ^{3}H/^{14}C ratio it was shown that cycloartenol and 24-methylenecycloartenol are not made via an intermediate containing as 8-9 double bond. 88 refs., 15 figs., 30 tabs.

17997 **(ORNL/Sub—81-09059/1) Cultural and management practices for the Chinese tallow tree as a biomass fuel source: Final report, 1978-1984.** Cowles, J.R.; Scheld, H.W. (Houston Univ., TX (USA)). Dec 1987. Contract AC05-84OR21400. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006156/JAW.

The growth and cultural conditions of the Chinese tallow tree, Sapium sebiferum (L.) Roxb., were studied over a 6-year period. Plots from seeds or seedlings at designated densities and plots established in natural stands were studied. The maximum growth rate of the Chinese tallow tree in a marginal soil near the Texas gulf coast was 10 to 15 dry tons/hectare/year. The young trees were able to withstand long periods of flooding as well as extended dry periods. The tree species also is resistant to diseases and pathogens. The Chinese tallow tree is particularly adaptable to close spacing, direct seeding, coppicing, and short-rotation growth cycles. These factors all favor the economic usefulness of the tree as a bioenergy species. In addition, the tallow tree is economically valuable in honey production and as a chemical feedstock. Fertilization is important during the early phases of stand establishment but has diminished usefulness in subsequent years. The Chinese tallow tree appears to be an excellent bioenergy species in the southern coastal areas of the United States and especially in marginal soils. The Chinese tallow tree has the potential of producing 15 to 20 tons/hectare annually by coppicing on a 5- to 8-year rotation at close spacings. 12 figs., 12 tabs.

17998 **(PIRSEM—2084) Influence of immobilization on the algae physiology in order to produce commercial molecules. Study of the cellular movement and environment coupling.** Puiseux Dao, S. (Centre National de le Recherche Scientifique, 75 - Paris (France). Programme Interdisciplinaire de Recherche sur les Sciences pour l'Energie et les Matieres Premieres). Dec 1985. 8p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751079/JAW.

The effects of blue and red light on Acetabularia mediterranea after a long dark period are studied. The different phenomenons occurring after algae are illuminated show that a coupling exists between the cytoplasm movement resumption and the electric activity resumption. Blue light is 100 times more efficient than white light. Electrical potential are very poorly stimulated by red light and only a part of cytoplasmic movements are induced.

17999 **Solvolysis of wood and pure cellulose by anhydrous hydrogen fluoride vapor.** Rorrer, G.L.; Ashour, S.S.; Hawley, M.C.; Lamport, D.T.A. (Michigan State Univ., East Lansing, MI 48824-1226, USA. Dept. Chemical Engineering; Michigan State Univ., East Lansing, MI 48824, USA. MSU-DOE Plant Research Lab.). *Biomass;* **22**: No. 4, 227-246(1987).

The solvolysis of bigtooth aspen wood and pure cellulose (filter paper) by anyhdrous hydrogen fluoride (HF) vapor was investigated. Each substrate was exposed to a 100% HF vapor stream at 0.101 MPa and 27 degrees C to 77 degrees C for a given reaction time. The water-soluble reaction products were then post-hydolyzed in 2N trifluoroacetic acid for 1 hour at 121 degrees C. With this two-step hydrolysis, maximum glucose yields of 85% from wood and 94% from pure cellulose were obtained. HPLC analysis of the water-soluble reaction products obtained before post-hydrolysis revealed that glucose and glucosyl fluoride repolymerized to oligomers during vapor-phase HF solvolysis of cellulose. The oligosaccharide product distribution was dependent on reaction time, temperature and sample water content. (Refs. 22).

18000 **(DOE/CH/10198—T4) Artificial photosynthesis using chlorophyll based carotenoid quinone triads: Technical progress report, [March 1985-14 June 1985].** Gust, D.; Moore, T.A. (Arizona State Univ., Tempe (USA). Dept. of Chemistry). 15 Jun 1985. Contract FG02-84CH10198. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003339/JAW.

Although initial results with carotenopyropheophorbide-quinone 8 are encouraging, the stability of this compound has been a problem. Consequently, a new triad with a modified structure is being prepared. Although the synthesis of this material will require some time, it is expected that the availability of a more stable triad will actually speed up the project at a later stage, and in addition will provide a material which has a greater probability of being useful for the design of practical solar energy conversion systems based upon photosynthesis. Once the new triad is available, it will be studied using the various physical techniques discussed in the proposal. These include nuclear magnetic resonance, laser flash

photolysis, fluorescence lifetime studies, and electrochemical studies in phospholipid bilayer membranes.

18001 **(DOE/ER/13242—4) Magnetic resonance studies of photosynthetic reaction centers and porphyrins: Progress report, June 1, 1987-January 10, 1988.** van Willigen, H. (Massachusetts Univ., Boston (USA). Dept. of Chemistry). Jan 1988. Contract FG02-84ER13242. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004955/JAW.

The primary event in photosynthesis is a charge separation reaction involving chlorophylls as electron donor molecules. Work performed has been concerned with photoinduced electron transfer reactions in systems that exhibit some of the photochemical characteristics of chlorophylls. Information on factors that affect charge separation is obtained by monitoring paramagnetic species generated in the reaction using electron spin resonance (ESR) techniques. Data on structure and dynamics of doublet and triplet state molecules were obtained with magnetic resonance methods. Of special interest is the application of Fourier Transform ESR methodology in the study of the electron transfer reaction from triplet zinc tetraphenylporphyrin (ZnTPP) to duroquinone. FT ESR provides data on dynamics of free radical formation and decay with nanosecond time resolution. The technique can give detailed information on reactions that proceed at close to diffusion controlled rates. Spin polarization effects give an insight into the mechanism of the charge separation reaction.

18002 **(DOE/ER/13546—2) Organization and regulation of the genes for nitrogen fixation in Rhodopseudomonas capsulata: Progress report, June 5, 1987-June 4, 1988.** Haselkorn, R. (Chicago Univ., IL (USA)). Feb 1988. Contract FG02-86ER13546. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005838/JAW.

We have cloned a number of fragments of DNA containing genes necessary for nitrogen fixation from the photosynthetic bacterium Rhodobacter capsulatus. The nif genes are locally clustered but the clusters are on non-neighboring DNA restriction fragments. We sought to determine the physical linkage of these fragments, to determine their relationship with the corresponding nif genes of Klebsiella, and to determine the nucleotide sequence of some of the fragments. So far we have identified six or seven regulatory genes among these, using a nifH::lac fusion. Four of the regulatory genes are required for expression of nifH. Two of these, nifR1 and nifR2, have sequences homologous to ntrC and ntrB of enteric bacteria. A third, nifR4, has sequence homology, in the C-terminal region, to the ntrA genes of Rhizobium and Klebsiella. Constitutive expression of nifR4 in R. capsulatus, from a plasmid clone, complemented a nifR4 chromosomal mutant but not a nifR1 mutant. Moreover, both oxygen and ammonia regulation of nitrogenase were maintained under these conditions. These results are consistent with a model requiring both nifR1 and nifR4 for nitrogenase gene expression; they rule out our earlier suggestion that nifR1 is needed only to turn on nifR4. Current efforts are focused on the purification of RNA polymerase and the products of nifR1, nifR2, and nifR4 to study nif gene transcription in vitro, particularly with the goal of determining the role of DNA supercoiling in transcription.

18003 **(LBL—24474) Structural studies of iron and manganese in photosynthetic reaction centers.** McDermott, A.E. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 168p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88005737/JAW.

Electron paramagnetic resonance (EPR) and x-ray absorption spectroscopy (XAS) were used to characterize components involved in the light reactions of photosynthetic reaction centers from spinach and a thermophilic cyanobacterium, Synechococcus sp.: center X, the low electron potential acceptor in Photosystem I (PS I) and the Mn complex involved in water oxidation and oxygen evolution. The dependence of its EPR amplitude on microwave power and temperature indicate an Orbach spin relaxation mechanism involving an excited state at 40 cm^{-1}. This low energy contributes to its unusually anisotropic g-tensor. XAS of iron in PS I preparations containing ferredoxins A, B and X are consistent with a model with [4Fe-4S] ferredoxins, which are presumably centers A and B and [2Fe-2S] ferredoxins, which would be X. Illumination of dark-adapted Synechococcus PS II samples at 220 to 240 K results in the formation of the multiline EPR signal previously assigned as a Mn S_2 species, and g = 1.8 and 1.9 signals of Fe^{2+} Q/sub A/$^-$. In contrast to spinach, illumination at 110 to 160 K produces only a new EPR signal at g = 1.6 which we assign to another configuration of Fe/sup 2+ - Q^-. Following illumination of a S_1 sample at 140 K or 215 K, the Mn x-ray absorption edge inflection energy changes from 6550 eV to 6551 eV, indicating an oxidation of Mn, and average valences greater than Mn(II). Concomitant changes in the shape of the pre-edge spectrum indicate oxidation of Mn(III) to Mn(IV). The Mn EXAFS spectrum of PS II from Synechococcus is similar in the S_1 and S_2 states, indicating O or N ligands at 1.75 +- 0.05 A, transition metal neighbor(s) at 2.75 +- 0.05 A, and N and O ligands at 2.2 A with heterogeneous bond lengths; these data demonstrate the presence of a di-μ-oxo bridged Mn structure. 202 refs., 40 figs., 7 tabs.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 17921, 17924, 17925, 17928, 17929, 17930, 17931, 17932, 17933, 17934, 17956, 18039, 18067, 18155

18004 **(AD-P—005698/6/XAB) High spacecraft potentials on ISEE-1 in sunlight.** Whipple, E.C.; Olsen, R.C. (California Univ., San Diego, La Jolla (USA). Center for Astrophysics and Space Sciences). 1987. 10p. NTIS, PC A02/MF A01.

This article is from The Aerospace Environment at High Altitudes and Its Implications for Spacecraft Charging and Communications. Conference Proceedings of the Electromagnetic Wave Propagation Panel Symposium Held in The Hague, The Netherlands on 2-6 June 1986, AD-A185 880, 8-1-8-10.

Data from the two electric-field experiments and from the plasma-composition experiment on ISEE-1 show that the spacecraft charged to close to -70 V in sunlight at about 0700 UT on March 17, 1978. Data from the electron-spectrometer experiment show that there was a potential barrier of some -10 to -20 V about the spacecraft during this event. The potential barrier was effective in turning back emitted photoelectrons to the spacecraft. Potential barriers can be formed by differential charging on the spacecraft or by the presence of space charge. The stringent electrostatic cleanliness specifications imposed on ISEE made by the presence of differential charging seem unlikely, if these precautions were effective. Modeling of this event to determine if the barrier was produced by the presence of space charge, suggested that this could not explain the observed barrier. The angular shape of the distribution could be successfully modeled as a product of differential charging on the solar arrays. This implies that the conductive coating was not completely effective in preventing differential charging, and that differential charging did occur.

18005 **(N—88-11745) Photovoltaic power modules for NASA's manned space station.** Tatro, C.A. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 13p. (NASA-TM—100229; E—3850; NAS—1.15:100229; CONF-880457—). NTIS, PC A03/MF A01.

From American Society of Mechanical Engineers Solar Energy Division conference; Golden, CO, USA (10 Apr 1988).

The capability and the safety of manned spacecraft are largely dependent upon reliable electric power systems. Two similar space power systems able to survive the low Earth orbit environment, are being considered for NASA's Manned Space Station (SS), scheduled to begin operation in the mid 1990's. The Space Station Electric Power System (EPS) is composed of Photovoltaic (PV) Power Modules, Solar Dynamic (SD) Power Modules, and the Power Management and Distribution (PMAD) System. One EPS configuration will deliver 37.5 kW of PV based, utility grade, ac power to SS users. A second 75 kWe PV based EPS option is also being considered for SS deployment. The two EPS options utilize common modules and differ only in the total number of PV Power Modules used. Each PV Power Module supplies 18.75 kWe of ac power and incorporates its own energy storage and thermal control. The general requirements and the current preliminary design configuration of the Space Station PV Power Modules are examined.

18006 (NP—8770039, pp 134-148) **Research and development of centralized type photovoltaic power generation system.** Miki, Shoji. (Shikoku Electric Power Co., Inc., Takamatsu, Japan). 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

A 1,000 KW-class centralized type photovoltaic power generation plant was completed in Saijo City, Ehime Prefecture in February 1986. The outline of the system is explained below. Solar cells; Single cristal cells form 77% of the whole cells and amorphous solar cells etc. are also provided. Both types are operated independently and a direct-current output of 1,448 KW was recorded on 19 April, 1986. Invertor; In order to make the systems coordinated operation as well as the independent operation feasible, a self-exciting method was adopted. Storage batteries and control device of charging and discharging; In order to generate electricity efficiently through combining solar cells arrays and storage batteries, ways of combination and selection of voltage were studied. Concerning the electricity storage device, a chopper circuit was attached to the device and the capacity of the storage batteries of 1,800 KW was set. With respect to the charging and discharging control method, a drop voltage charging method was adopted. Direct-current electricity collecting lines; In order to reduce construction costs, the capacity of one circuit of collecting trunk lines was set to be about 50 Kw and CV cables were chozen as the kind of cable to be used. Operational record; During the period from April to June, electric power of 120 MWh was generated every month. This supposes that electric power of about 1,440 MWh is to be generated annually. (15 figs, 3 tabs)

18007 (NP—8770039, pp 149-169) **Stand-alone photovoltaic power system. System for isolated islands, for offshore use, and for desalination plant.** Kurokawa, Kosuke. (Electrotechnical Lab., Tsukuba, Japan). 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

The current situation of developments is to be reported concerning independent dispersed systems of various photovoltaic power systems which are located on the beaches and offshore. Electricity supply system for isolated island; This is an operational system of utilizing the features of solar power and Diesel power with the former as the main electric source and the latter as auxiliary and full automation of operation control and emergency shifting of electric sources etc. were planned so that unattended operation may be performed except a patrol and inspection about once a week. Electrodialysis system of desalination of sea water for isolated island; The system's capability of energy-saving, durability and handling were improved thanks for technological evolution and the system was reevaluated favorably as an excellent desalination method. In particular, the system in combination with solar power demonstrates its favorable characteristic features. Offshore system; This is an electricity supply system for an ocean firm. It is used as the electric sources for feeding robots, buoys, fish shoals with electric setting and control and measurement devices. Concerning the capacity of the system, 10 KWp at the maximum output with load of 11 KVA was set on the assumption that the whole power output of solar batteries are to be utilized effectively. (13 figs, 3 tabs)

18008 (NP—8770044, pp 184-194) **Development of commercialization technology on solar cell power generation system. Development of peripheral technologies.** Takeda, Yukihiro. (Central Reserch Inst. of Electric power Industly, Tokyo, Japan). 21 Sep 1984. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

In Proceedings of parallel sessions for the 4th NEDO general assembly.

On the basis of the research data by 1982, studies were started on the improvement of the quality of the power generated, establishment of safe and sure protection and maintenance by experimentalily connecting to a compact solar power generation systems with 2 KW and 3 KW respectively. Prior to this operation test, the action of the security equipments was checked to confirm their aptitude for such troubles as short-circuiting and earthing for both DC and AC circuits. Then a field test was carried out to verify the result of the basic research in the previous year. Basic data for the design of an optimum system was accumulated. The study on the influence of the surface contamination and the change in the module characteristics revealed that the array surface contamination was critical in the system design. (5 figs)

18009 (NP—8770044, pp 195-227) **Development of solar system technology for industry. An underground heat storage system.** Miyagawa, Yasuyuki. (Obayashi Corporation, Tokyo, Japan). 21 Sep 1984. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

In Proceedings of parallel sessions for the 4th NEDO general assembly.

Two units of underground heat storage tank were installed by a precast basement method (PB method) to check the thermal characteristics within the heat accumulating tanks. The test results indicated that the tanks were ideal from such viewpoints as installing accuracy, installing cost, applicability to further large scale, and the site adaptability. Burying of the piping in the PC plate and the use of PVC-based water-proofing sheet were found free of any trouble. When compared with the conventional tanks installed on the ground, both the heat gain insummer and the heat loss in winter for the underground heat accumulating tanks were of the 1/3 level only. Preliminary operation of heat accumulation showed the existence of a favorable heat layer despite the lack of any separator plates. (27 figs, 8 tabs)

18010 (NP—8770045, pp 201-222) **Solar system technology for industry. Development of a cascaded heat process system.** Sakai, Hiroo. (Hitachi Ltd., Tokyo, Japan). 20 Sep 1985. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

In Proceedings of parallel sessions for the 5th NEDO general assembly.

This is a report for 1985 for NEDO contracted project. In order to attain a stable supply of heat to the processes wherein the temperature must be stepwise applied, a system was designed for five units of wool fabric dye-bath. A heat collector to produce pressurized hot water of 130 'C for a temperature controlling application was tried to be developed utilizing a flat penetrating type heat collector, available in the market, with 45 'C low temperature capacity and 70 'C high temperature capacity. Maximum allowable temperature in a collector loop was 165 'C, and the heat collecting efficiency attained was 46 % exceeding the target value of 45 %, per one collector unit. Heat collecting efficiency of the verification plant as a group of high temperature heat collectors was 15 % lower than the single collector unit due to the heat loss from the piping joints. According to the simulated study on the effect of the cascade operation, the amount of the heat collected was estimated to increase by roughly 8 %. (18 figs, 5 tabs)

18011 (NP—8770046, pp 284-292) **Development of commercialization technology of photovoltaic power generation. Verification on experimental production of solar cell panel (dry PN junction process).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This study was performed as one of research projects funded by NEDO. And the study is aimed at a development of dry PN junction process as one of the R and D items required for the low cost mass-production of solar electric cell panels. Therefore, in accordance with the trial operation research and studies on process improvements, a relationship between the substrate quality and cell characteristic was studied, and various data were collected, and an experimental production was performed to produce panels for the field tests under an intensive arrangement system. In this fiscal year, in order to increase an efficiency of the following element studies have been performed on operation researches (1) A research on a process material to prevent the decrease in life time within the process. (2) Studies on facility improvements. (3) A research on formation of a multi-layer reflection preventing membrane using a thin membrane forming unit. (4) A research on formation of a high speed uniform reflection preventing membrane. (5) A study on formation of an ultra-fine electrode. Further, on research for the whole process, a relationship was studied for the SOG cast fed

from the previous process, the quality of the ribbon base and the cell characteristic. And in the internal process research, a life time measuring method on a low resistance base plate was studied and a promissing outlook was obtained enabling a measurement feasible by means of an infrared absorption method. And the formation of an ultra-fine electrode was studied and by a cast cell a product with a maximum efficiency of 124% was obtained. And on a research covering the whole process, by means of a comparison on the cell characteristic before and after the hydrogen addition, a short-circuit current density of 55% at maximum, and a cell efficiency improvements by 60% at maximum was obtained. (6 figs)

18012 (NP—8770046, pp 429-436) **Research and development of periphery technology. R and D on solar cell frame, study on solar sell array integrated with building material-personal residence.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

Technical problems, economy, problems at commercialization, etc. were investigated. (1) A structure of amorphous silicon solar cell formed on a glass substrate was found superior. (2) Location of the solar cell was found better on the roof than on the wall by means of simulated study. (3) Considerable cost reduction as a whole system is possible because the integrated solar cell does not require a frame. Reduction of module cost is also expected especially in the case of amorphous silicon. (4) Mandatory controls in relation with the commercialization of this technology were examined. (5 figs, 4 tabs)

18013 (NP—8770046, pp 460-463) **Research and development of peripheral technology of photovoltaic power generation. Research and development of testing evaluating methods of peripheral equipment.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

In order to determine the specifications required for the peripheral equipment necessary for composing the photovoltaic power generating systems as the independent power source and as a part of the power distribution system and to establish its uniform testing and evaluating methods, research works were carried out and the following results and knowledge were obtained; 1) Study of specifications required for peripheral equipment; The most suitable conditions and design points etc. of such peripheral equipment as solar cell supporting rack, invertor and battery were studied and the basic draft specifications for each peripheral equipment were prepared. In particular, concerning invertor, the possible approaches to find out the control method, which is stable and efficient against changes of the insolation and climate and other conditions were considered. 2) Study of uniform testing and evaluating methods of peripheral equipment; Testing and evaluating methods of each peripheral equipment and other similar equipment were studied and testing and evaluating methods used in other countries were investigated and examined.

18014 (NP—8770046, pp 472-479) **Research and development of utilization system of photovoltaic power generation. Research and development of the system for schools.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is the report of the achievement in 1985 mainly about the continuous operations of the 200KW-class power system. The composition of the most suitable system was examined through obtaining the continuous data on the various operational conditions and assessing the electricity generating characteristics. At the same time, in order to grasp the patterns of the electric power for schools, they were investigated at various facilities of Tsukuba University. Furthermore, the research of the system simulation was contracted with Tsukuba University and carried out. Concerning solar cell arrays, cells were grouped in eight different kinds and the data on their behaviors by individual groups were measured. By measuring the voltage-ampere characteristics of each subarray, the contamination rate due to the surface contamination was calculated. Concerning the elemental equipment, their performance was studied and assessed from the data of the continuous operations. Besides the power control of the invertor was improved and the control device to protect overcharging and overdischarging of the battery was modified. (4 tabs)

18015 (NP—8770046, pp 480-488) **Research and development of utilization system of photovoltaic power generation. Research and development of the system for factories.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is the report of the achievement in 1985 concerning proving operations of a 100KW electricity generating plant and the study of solar cell array systems by the mini assessment system. Continuous operations of the plant for a year were done smoothly and with regard to the dependence rate on the solar energy, the utilization rate of the system and the electricity generating efficiency of the system, the results obtained were approximately the same as the designed values. Investigations were also made about the relationship between the output power and the output voltage of each cell block, the effects due to the existence of auxiliary batteries and the variation of connecting modes, etc.. The total system was also analyzed. Regarding the array systems, investigations were made on different array installation conditions about the output power patterns, the total output power per day and the efficiency of each module of CZ, CAST, Cds/CdTe, and a-Si, by using newly manufactured fixed as well as movable array racks. Through the above, an examination was made in order to find out the most suitable array system. (9 figs, 3 tabs)

18016 (NP—8770046, pp 489-494) **Research and development of utilization system of photovoltaic power generation. Research and development of systems of stand-alone photovoltaic power system (system for mountainous areas).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

The objectives of this project are to develop an economical and easily maintainable system by applying the photovoltaic power generating system to the facilities such as a hut in the mountainous area, and study its actual electricity generating performance and weatherproofness. The research started in June, 1984. Firstly, the system was started as 5 KW system in December, 1984 and the following examinations and improvements were made; 1) the composition of the snow resistant roof panel, 2) the measures against the seasonal variation of the generated power and 3) the measures for improving the operational efficiency. The effects of these improvements will be obtained through a yearround operation. Concerning test operations, very smooth operations have continued without any stoppage of the system due to troubles since its start of the operation in December, 1984 and the collection and analysis of the actual operation data were made. Furthermore, the investigation and analysis of the actual snow accumulation on the array surface with video equipment have been done since the winter of 1984. Hereafter, the study of the most suitable way of utilizing the supplementary electric source, etc. will be pursued additionally. (2 figs, 1 tab)

18017 (NP—8770046, pp 495-507) **Research and development of utilization system of photovoltaic power generation. Research and development of stand-alone photovoltaic power system (power supply system for remote island).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

The objectives are to execute, by constructing the proving facilities, the technology development of an economical and easily maintainable photovoltaic power supply system, the research of the parallel operation technology with the Diesel electricity generation, the technology of the unattended operation, and the electricity generating characteristics. In 1984, the research started in June and based upon the technological development of the power supply system for a remote island with solar power as the main electric source and Diesel as the supplementary, the detailed design work of the proving facilities was done. At the same time, such system equipment as photovoltaic cell modules, invertors and batteries, etc. were also manufactured. Continued from 1984 and as scheduled in 1985, such system equipment as solar cell arrays (for remaining

25KW), the data collecting and recording apparatus and the far-reaching voice reporting devices were designed and manufactured. Concerning the operation research of the proving facilities, the collection and analysis of the actual operational data were made through independent operation tests and operation tests in coordination with the Diesel power supply. (7 figs, 3 tabs)

18018 (NP—8770046, pp 508-516) **Research and development of utilization system of photovoltaic power generation. Research and development of stand-alone photovoltaic power system (desalination system for remote island).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

In order to develop the most suitable compound system by means of the systematic combination of the photovoltaic power generation technology and the electrodialysis desalination technology of sea water and to plan its application for the practical usage in the area which is short of the water resources, the project started from 1984. Based upon the environmental conditions of Ohshima island, Nagasaki Prefecture and its basic design which were obtained as the achievements in 1984, the detailed design of the proving plant was done. The proving plant of the sea water desalination system for remote islands is a system of stand-alone type that the power which is generated by solar cells is used directly by an electrodialysis apparatus in the uninverted form of direct current and a part of it is inverted to alternating current by a 7.5 KVA invertor in order to be consumed as the power for the supplementary equipment, etc. Surplus power during the day time is stored in a battery of 1,200 Ah which may become the power to be supplied at the time of the low concentration desalination operation. Because of the above, the system has the composition which can utilize the solar energy highly efficiently and its total electric power output generated through the year is 24,685 KWH/a (designed generating power out put). (4 figs, 2 tabs)

18019 (NP—8770046, pp 517-522) **Research and development of utilization system of photovoltaic power generation. R and D of stand-alone power system (for marine use).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is an annual report for 1985 for NEDO contracted project. The project aims at establishing an efficient, stable power generating solar cell technology and developing a power supply system for the ocean development. In order to install an independent off-shore power supply system for the marine ranch at Kamiura, Oita Prefecture, a frame berge was constructed on the Tsuinoura pier and an annularly arranged disc type solar cell with the center tapered at 4 % in an umbrella shape towards outside. Designed capacity was 10 KWp maximum output, and total 11 KVA (1 KVA at heavy duty load and 10 KVA at sun-shining load). The power source system consists of units for solar cell, power storage, control, orthogonal conversion, and of various loads. The system can make a normal observation by a wireless data transmission from off-shore onto the ground. (2 figs, 4 tabs)

18020 (NP—8770046, pp 523-535) **Research and development of utilization system of photovoltaic power generation. R and D of stand-alone system (methane gas hybrid system).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is an annual report for 1985 for NEDO contracted project. A verification unit was installed at Haruyama hog raising center in Kagoshima Prefecture for establishing a commercialization technology of a hybrid system utilizing both solar cell generation and methane gas power generation. Total capacity of the solar cell was set at 30.24 KWp by charge controlling by means of cyclic open-and-close control of 5 blocks of load. Methane gas fermentation unit consists of a 60 m^3 fermentator and a 40 m^3 gas holder, 3-phase 220 V, 20 KW gas power generator. A D.C. side connection system was adopted wherein the capacity of the inverter unit was 3-phase, 5 KVA, and 3-phase, 20 KVA, mono-phase 5 KVA, and mono-phase 10 KVA. In the system, the solar cell works dually to supply the power for the daytime load and for charging the storage battery, and the methane gas unit is operated in two stages at night and simultaneously charge the storage battery and supply power to the load, and is automatically controlled by a control unit. (6 figs, 1 tab)

18021 (NP—8770046, pp 536-542) **Research and development of utilization system of photovoltaic power generation. R and D of stand-alone system (wood power generation hybrid system).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is an annual report for 1985 for NEDO contracted project. This project aims to verify the practical performance of a hybrid photovoltaic/wood power generation system for the resort and educational facilities in the hilly or forest areas. Average power consumption at load for August was 14.6 KWH/d and the hourly power consumption data confirmed the night pattern. Capacity of the power generation was set at 5 KWp for the solar cell and 1.4 KW for the wood power generation. Capacity for the orthogonal converter and the storage battery was 5 KVA and 172.8 KWH (for 3 days) respectively. The system is constructed on the basis of parallel operation of the solar power generation and the wood power generation, system protection, automatic data collection, and field testing. Then the respective equipment was designed, manufactured, and installed at the Nature Club Center; data measuring instruments were attached to completed the experimental research system. (3 figs)

18022 (NP—8770046, pp 543-550) **Research and development of utilization system of photovoltaic power generation. R and D of stand-alone system (desalination system for remote island-reverse osmosis).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This system is an independent system which utilizes DC power obtained by a solar cell for the power source for a sea water desalination plant. The system is constructed of 2 series of a reverse osmosis membrane module system by which the power storage requirement in the battery is minimized by storing in the form of water instead. Effective battery capacity is 46.2 KWH which corresponds to the operation of 0.7 days. Hoso-jima in the central part of the Seto Inland Sea is estimated as the plant location and satisfies the conditions of this verification test. It is being examined to use the solar cells of single and poly crystal types as they have been often practically used to a considerable extent, because the test plant is going to be used as a commercial plant after the test operation is completed. Nominal capacity of 0.55 m^2/h was set for the reverse osmosis sea water desalination unit on the basis of 4.5 m^2/d (a daily average for the agricultural water required for 1,000 m^2 hydroponic area). Annual average water production is roughly 5.3 m^2/d. (2 figs, 1 tab)

18023 (NP—8770046, pp 551-555) **Research and development of utilization system of photovoltaic power generation. R and D of stand-alone system (system for broadcasting satelite).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

Minami-Yotei district (Hokkaido) is the best location because an opening of a broadcasting satellite station is strongly desired due to its hard listening condition in addition to its extreme cold climate and the remote location. Fundamental concept of the system is as follows: Power supply: The entire load is supplied by a solar cell panel and a cell unit. An engine generator is contemplated as a back-up power source. Charge/discharge control system: Control by terminal voltage of the cell, and by the detection of charge/discharge. Protection and alarming unit: For D.C. earthing, overcurrent, and battery temperature increase, etc. Instrument: For measuring the weather and power generation data. (2 figs, 1 tab)

18024 (NP—8770046, pp 556-561) **Research and development of utilization system of photovoltaic power generation. R and D of stand-alone system (light-wind hybrid system).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

Evaluation on the natural energy distribution, cost reduction technology, and economy was made in order to clarify the possibility of the titled system. Shizuoka Prefecture was selected; annual power production by 30 KWP solar cell was 44,078 KWH; annual power production by 2 units of 18.5 KWP wind power generator was 68,444 KWH. Both energy are the energy available only in the daytime, and the pattern of load in the facility horticulture balanced with the energy distribution characteristics. The system is constructed with a hybrid of a solar cell and a wind power generator, and efficiently absorbs the energy of light and wind by the current control. Evaluation of an energy used for the estimated independent power source indicated the possibility of energy-saving (on the basis of heavy oil A) of 16 kl per annum, i.e., electric power of 79,700 KWH. (1 fig, 1 tab)

18025 (NP—8770046, pp 562-575) **Research and development of photovoltaic power utilization system. R and D of stand-alone systems (tunnel illuminating system).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This research was performed as one of the studies funded by NEDO. The research is intended to study the utilization method of solar cells as independent dispersed type and other systems as well as the consequent economic effect, therefore, to investigate the locating conditions, to execute the basic design of the system and, to survey the demand, etc. with regard to the current tunnel illuminating system of high energy cost. A field survey was performed on the feasibility of the tunnel illuminating system at Miyazaki Prefecture where there are plenty sunshine and many tunnels, and in addition, a nationalwide market research on the application of the system was conducted. Further, from the viewpoints of the locating conditions, the amount of traffic and the magnitude of illumination, the tunnels good for the demonstration of the tunnel illumination by the solar energy were selected and a basic design was performed. As a result of the study performed on the economic performance, in taking the cost-down in the future into account, the tunnel illumination by the solar energyr is concluded to be promising for the four tunnels in Miyazaki Prefecture. (6 figs, 3 tabs)

18026 (NP—8770046, pp 576-579) **Research and development of photovoltaic power generation. R and D of stand-alone system (artificial facility cultivation system).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This research was performed as one of the studies performed by NEDO. The study is intended to develop an automatic artificial facility cultivation system of energy saving type utilizing electric power generated from solar cells as a power source for a ventilation and irrigation system (no heating) or a ventilation, irrigation and heating system (heating by application of the underground heat). In order to design an artificial facility cultivation house of an stand-alone type, firstly, a survey was carried out on (1) the situation of the currently available house installations, etc. (2) the existing data on temperature, insolation and operating conditions, etc. and (3) the selection of units to be applied. Subsequently, a simulation on the heat balance in and out of the house, and a basic design were performed. As a result of the study, in so far as the artificial facility cultivation system based on photovoltaic power concerned, it was found that its application to the air ventilation and irrigation system of non-heating type is worth recommending since its application to heating costs significantly more and becomes difficult. (1 tab)

18027 (NP—8770046, pp 580-587) **Research and development of centralized type photovoltaic power generating system. R and D of dispersed array type power system.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This research was performed as one of the studies funded by NEDO. The study is intended to establish a centralized array type photovoltaic power generating system (dispersed array type) in order to expand the use of solar cells. By using a system of 200 kw in total capacity consisting of 6 units completed by the previous fiscal year, a demonstration test was performed and the effects on the power quality in case when solar cells connected to the distributing line. The operational characteristics of the system against the load fluctuation of the distributing line, and the protection and safety measures at the time of the system stoppage were studied. A general operation method of the system as a dispersed array type system was also studied. As a result, it was confirmed that even in case where the solar power generating system is introduced into the power distribution system up to about 80 % of the latter's total capacity (assumed as 2500 KVA), the voltage fluctuation factor remains within 5 % and the increase of the general voltage distortion factor with about 2 %. (3 figs , 1 tab)

18028 (NP—8770046, pp 588-595) **Research and development of centralized type photovoltaic power generation system. R and D of centralized array type photovoltaic power generation system.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This research was performed as one of the studies comissioned by NEDO, and the study was intended to establish a photovoltaic power generating system (centralized array type) of the centralized type to expand the use of solar cells. In this study, based on the research result obtained in the previous fiscal year, the confirmation and re-examination on the specifications to be applied for the centralized arrangement system were carried out, while by the additional installation of solar cell arrays, inverters and storage batteries to the existing system, a 1,000kw class power generating system was completed and connected to the 6.6 kw system already available in order to grasp the basic characteristics of the centralized arrangement system. As a result of the analysis on the operating performance of the 1,000kw system, it was clarified that the panel conversion efficiency had been increased every year due to the improving performance of crystalline type solar cells with the result that it reached 10.5% in the fiscal year 1985. And in order to decrease the construction cost of the array rack, a wind tunnel test was performed, and based on the result, a design manual was prepared. (6 figs, 1 tab)

18029 (NP—8770046, pp 596-599) **Research and development of centralized type photovoltaic power generation system. Research and development of centralized array type photovoltaic power generation system (environment study on waterborne location).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is a report on the experiment and feasibility study of the photovoltaic power generation system on waterborne location for the purpose of developing the utilization technology of photovoltaic power generation. 1. Outdoor experiment: An outdoor test of a power generation system with the total capacity of solar cells of about 1 KW (number of module: 20, power output: 210 W) was carried out in order to perform the overall evaluation of the conceptual design executed in previous years. At the same time, a system model was set up and an experiment was made to apply photovoltaic power generation to a lake purification system. 2. Reexamination of conceptual design: The outdoor experiment of the floating body was confirmed that the results obtained by the cistern experiments in the previous years were proper and a method of designing the floating body for waterborne location was established. Also the feasibility of the electric and purification systems was clearly confirmed.

18030 (NP—8770046, pp 425-428) **Research and Development of solar cell frame. Study on solar cell array solid with building material-business building.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is a NEDO annual report for 1985. A feasibility study was carried out from the viewpoints demanded both from the building material side and the solar cell. Evaluation from the technical, institutional, and economical viewpoints indicated the possibility of using a roof material solid with carbon-fiber-reinforced concrete and a curtain wall. The solar cell module was verified as a building material to be resistant against the external force, water, and heat. A problem left is how to enlarge the module. Integrated

use of CFRC (Carbon Fiber Reinforced Concrete) and a cell of maximum size (1,240 x 700 mm), which is industrially available, can be expected. Present solar cell array can be utilized as a building material as it is for a curtain wall. Cost calculation of the CFRC solid roofing material indicates 276 yen/KWH for 15 years depreciation, 10 % residual value, and 8% annual interest, which is a little expensive, but this cost may be applicable to the use as a curtain wall.

18031 (NP—8770046, pp 600-609) **Research and development of photo-thermal hybrid type photovoltaic power generation system.** Aug 1985. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is a report on the study of a photo-thermal hybrid panel system supplying energy to the demand of electricity and heat for private housing. 1. Primary test manufacture of a hybrid panel. It is effective for trapping solar energy at the maximum yield with a limited roof area of private housing to apply photo-thermal hybrid panels combining solar cells with solar heat collectors. A simulation calculation was conducted for the hybrid panel with a structure of crystalline solar cells combined with black liquid type collectors. Also, the primary test manufacture of the panel was effected in order to conduct a concentration test. Futher, a test system for evaluation of the panel was manufactured and introduced. 2. System simulation and conceptual design. The model weather was set up and simulation programs for respective electric and thermal cycles making use of the model weather were developed. Furthermore calculation for grasping the outline of the respective characteristics was made. (9 figs, 3 tabs)

18032 **Photovoltaic electrical system design practice: Issues and recommendations.** Key, T.; Menicucci, D. (Sandia National Labs., Albuquerque, NM 87185). pp 1128-1133 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

As demand for photovoltaic (PV) power grows, so will the need to improve electrical subsystem safety and reliability. This paper documents some of the most significant electrical design problems and solutions experienced in fielded PV systems. The major focus is analysis of wiring, grounding and protection problems and employment of design lessons learned from their solution. Based on design experiences, general criteria are identified and electrical subsystem design practices are recommended for three classes of PV system applications.

18033 **Design, installation, and operation of a 13 KW photovoltaic-powered water well.** Davis, R.E. (Holmes and Narver, Inc.). pp 1041-1044 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

This paper discusses the design, installation, and operation of a stand-alone, 13KWp, flat plate, photovoltaic-powered, very deep water well pumping project. The paper concludes with recommendations and cautions for both the photovoltaic and engineering communities addressing the problems that can be expected to accompany future expansion of photovoltaic applications for other than very small installations.

18034 **An evaluation facility for photovoltaic water pumping systems.** Chamberlin, J.L. (Sandia National Labs., Albuquerque, NM 87185). pp 1036-1040 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

A facility for the evaluation of photovoltaic-powered water pumping systems has been installed at Sandia's Photovoltaic Advanced Systems Test Facility (PASTF). This paper describes the facility which consists of an instrumented flow loop capable of handling pumps with capacities up to 90 gpm at simulated well depths up to 400 feet. The pumps can be operated either by a power supply, which permits rapid determination of a pump's operational characteristics, or by a photovoltaic array, which permits simulation of field operation. Data is collected and processed by means of a computer-based data acquisition system. Examples of test results demonstrating some of the facility's capabilities are presented.

18035 **Photovoltaic water pumping for Bolivia.** Post, H.N.; Garvison, P. (Sandia National Labs., Albuquerque, NM 87185). pp 1345-1350 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

This paper describes the design, installation and performance of photovoltaically-powered water pumping systems which provide potable water to residents of three villages in the Altiplano region of Bolivia. The installation of these systems during August 1986 was the culmination of a cooperative effort between The World Bank, U.S. Department of Energy and the Bolivian government. This project was configured to demonstrate, through pilot systems, the many potential benefits of using photovoltaic water pumping in developing countries. The lessons learned through the procurement and installation of these systems are discussed and the resulting benefits of the project to international lending institutions, U.S. industry, and the Bolivian participants are examined.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 18047, 18051, 18052, 18053, 18054

18036 **(SAND—87-7020) Central heat engine cost and availability study.** (Mechanical Technology, Inc., Latham, NY (USA)). Nov 1987. Contract AC04-76DP00789. 172p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88003200/JAW.

This report documents the performance and cost of commercially available heat engines for use at solar power plants. The scope of inquiry spans power ratings of 500 kW to 50 MW and peak cycle temperatures of 750 °F to 1200 °F. Data were collected by surveying manufacturers of steam turbines, organic Rankine (ORC) systems, and ancillary equipment (steam condensers, cooling towers, pumps, etc.). Methods were developed for estimating design-point and off-design efficiencies of steam Rankine cycle (SRC) and ORC systems. In the size-temperature range of interest, SRC systems were found to be the only heat engines requiring no additional development effort, and SRC capital and operating cost estimates were developed. Commercially available steam turbines limit peak cycle temperatures to about 1000 °F in this size range, which in turn limits efficiency. Other systems were identified that could be prototyped using existing turbomachines. These systems include ORC, advanced SRC, and various configurations employing Brayton cycle equipment, i.e., gas turbines. The latter are limited to peak cycle temperatures of 1500 °F in solar applications, based on existing heat-exchanger technology. The advanced systems were found to offer performance advantages over SRC in specific cases. 7 refs., 30 figs., 20 tabs.

18037 **(SERI/PR—255-3057) Polymer reflectors research during FY 1986.** Schissel, P.; Neidlinger, H.H. (Solar Energy Research Inst., Golden, CO (USA)). Sep 1987. Contract AC02-83CH10093. 134p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88001101/JAW.

The long-term objectives of the Silvered Polymer Reflectors subtask within the SERI Solar Thermal Research Program are to develop silvered polymers that have a high specular reflectance and to develop modifications of polymers that will protect the silver and maintain the reflectance in outdoor environments for many years. Major progress has been made toward the specific long-term targets of a specularity resulting in 90% of the solar flux being contained within a cone angle of 4 to 10 mrad, and a useful life of at least 5 years. We have shown that silvered polymers can have an initial specular reflectance well over 90% into an acceptance angle

of 1 to 2 mrad, significantly better than our long-range goals. It was further shown that these results could be obtained when the silvered polymer was mounted with an adhesive onto a smooth, flat substrate or stretched as a membrane without a firm support as in the membrane mirror configuration. Thus, the initial optics exceeds our goals, and the focus of our work is now directed to the durability of silvered polymers. Durability studies using industrial silvered polymers are conducted in accelerated weathering devices and outdoors. Outdoor tests in Colorado show that silvered polymers can maintain reflectances in excess of our long-range goals (>90%, 4 mrad) for at least 48 weeks (18% of our durability goal) and the tests are continuing. Materials placed into test earlier, before we attained the full optical performance, are also providing encouraging results. Samples outdoors in Golden, Colo., for 2 1/2 years maintain reflectances near 90% at 12 mrad while other samples here avoided silver corrosion as determined by visual inspection for nearly 3 years. 39 refs., 56 figs., 11 tabs.

18038 **(SERI/SP—273-3054) Power from the sun: Principles of high temperature solar thermal technology.** Stine, W.B. (Solar Energy Research Inst., Golden, CO (USA)). May 1987. Contract AC02-83CH10093. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE87001104/JAW.

This report describes the development of solar thermal technology by looking at the fundamental principles of solar thermal components and systems, discussing the technical issues that enhance or limit their development, and describing their evolution to its current state. It is written for those who want to understand the solar thermal conversion process. The reader should realize that many concepts here are highly simplified so that only the major points are emphasized. Detailed engineering, mathematics, and physics underlies this simplicity.

18039 **(SAND—86-1943) Control strategies and hardware used in solar thermal applications.** Adkins, D.R. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1987. Contract AC04-76DP00789. 136p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88004631/JAW.

The control technology used in solar power production has gone through several changes over the past decade. To highlight some current aspects of solar collector control technologies, this report examines procedures and hardware for tracking the sun and regulating receiver temperatures. Requirements placed on controls for system protection and reliability are also reviewed. Control experienes in point- and line-focus concentrators, central receiver systems, and photovoltaic arrays are included in this study. 77 refs., 26 figs., 2 tabs.

18040 **(SAND—87-1424C) Direct absorption receiver control studies.** Tyner, C.E.; Kolb, G.J. (Sandia National Labs., Albuquerque, NM (USA)). 4 Sep 1987. Contract AC04-76DP00789. 18p. (CONF-880320—1-Draft). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE87013653/JAW.

From ASME solar energy conference; Denver, CO, USA (1 Mar 1988).

In a solar central receiver system Direct Absorption Receiver (DAR), the heat absorbing fluid (a blackened molten nitrate salt) flows in a thin film down a vertical panel (rather than through tubes as in conventional receiver designs) and absorbs the concentrated solar flux directly. This unique flow system presents different control requirements than other receiver systems. In this paper we discuss these requirements, including analyses of multiple control zones for various receiver geometries and steady-state flux patterns. These results show that as few as 9 to 13 control zones can provide adequate operation of the receiver under nearly all conditions. We also discuss the simple outlet-temperature-feedback control algorithm developed to control the DAR during cloud transients and present system thermal/hydraulic responses to various transient conditions. 11 refs., 9 figs., 3 tabs.

18041 **(SAND—87-8182) Central Receiver Plant evaluation: (2) THEMIS collector subsystem evaluation.** Amri, A.; Izygon, M.; Tedjiza, B. (Sandia National Labs., Livermore, CA (USA)). Jan 1988. Contract AC04-76DR00789. 136p. NTIS, PC A07. Order Number DE88005110/JAW.

This report is part of the evaluation work carried out at Ecole Centrale on central receiver plants. The THEMIS collector subsystem is evaluated with emphasis given to the energy performance problems. The collector subsystem, the heliostat, and the operation modes are described. The mechanisms which contribute to the energy losses of the collector subsystem are discussed individually. Heliostat availability, reflectivity, geometrical effects (mirror shadowing and blocking, cosine factor, tower shadowing), beam focusing quality, beam pointing, spillage, propagation losses in the atmosphere between the mirrors and the receiver are successively evaluated. The overall collector efficiency is then estimated from two different points of view. The theoretical performance showing the physical limitation of the system, and the actual performance based on real experimental results, are separately discussed. The electricity consumption of the heliostat field is examined for plant parasitics analysis. The maintenance problems and the lessons learned on hardware behavior at the THEMIS site are also discussed. 19 refs., 7 figs.; 24 tabs.

18042 **(SAND—88-8200) A bibliography of Sandia National Laboratories solar central receiver reports: 1984-1987.** Radosevich, L.G.; Skinrood, A.C. (Sandia National Labs., Livermore, CA (USA)). Jan 1988. Contract AC04-76DR00789. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005867/JAW.

The 1984-1987 published reports of the technical information developed by the Sandia National Laboratories solar central receiver program are compiled. An abstract of each report is included. Reports are listed by both report number and author.

18043 **(SAND—87-1533) Design of the Sandia-Israel 20-kW reflux heat-pipe solar receiver/reactor.** Diver, R.B.; Ginn, W.C. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88001312/JAW.

This report describes the design and fabrication of a 20-kW sodium reflux heat-pipe solar receiver/reactor for CO_2 reforming of methane. This project is part of a bilateral agreement between the United States and Israel. Under the terms of the agreement the solar receiver/reactor has been designed and built by Sandia National Laboratories for testing in the 7-meter solar furnace facility at the Weizmann Institute of Science in Rehovot, Israel. 16 refs., 11 figs., 2 tabs.

18044 **(SAND—87-1753) Oxidation/sulfidation of materials in an $SO_3/SO_2/O_2$ thermochemical-transport, distributed-receiver, solar-energy system: Final report.** Weirick, L.J. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1987. Contract AC04-76DP00789. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005875/JAW.

Metals for potential use in the dissociator and the synthesizer reactors of a distributed solar-receiver, thermochemical-transport loop using $SO_3/SO_2/O_2$ molecular chemistry were tested in SO_3 gas at 500°C and 900°C, respectively, for periods up to 8 weeks and in a cyclic-temperature mode from 200°C to 900°C, representing the diurnal solar cycle, for 35 days. They included iron-base, nickel-base, and coablt-base superalloys. Weight-gain measurements were used to determine the oxidation/sulfidation kinetics. Electron-microprobe analysis identified any possible penetration of oxygen and sulfur into the metal and the formation of internal oxides and sulfides. Selected iron-base, nickel-base, and cobalt-base alloys look promising as candidates for the synthesizer reactor which operates at ~500°C. The most promising candidate for the dissociator reactor that operates above 900°C is Kanthal A-1, which contains sufficient quantities of both aluminum and chromium alloying additions to be an alumina and chromia former. 10 figs., 3 tabs.

18045 **Photovoltaic/diesel hybrid systems: The design process.** Jones, G.J.; Chapman, R.N. (Sandia National Labs., Albuquerque, NM 87185). pp 1024-1030 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

A photovoltaic/storage system by itself may be uneconomical for stand-alone applications with large energy demands. However, by combining the PV system with a back-up energy source, such as a diesel, gasoline, or propane/thermoelectric generator, system economics can be improved. Such PV/fossil hybrid systems are being used, but their design has required detailed modeling to determine the "optimal" mix of photovoltaics and back-up energy. Recent data on diesel field reliability and a new design technique for stand-alone systems have overcome this problem. The approach provides the means for sizing the photovoltaic system to obtain a near optimal hybrid system, with about a 90% savings in back-up fuel costs. System economics are determined by comparing PV capital cost to the present value of the displaced diesel operation and maintenance costs.

1408 Ocean Energy Systems

18046 (DOE/CH/10093—14) Federal Ocean Energy Technology: Program summary for fiscal year 1986. (Meridian Corp., Falls Church, VA (USA); Science Applications International Corp., McLean, VA (USA)). Oct 1987. Contract AC02-83CH10093;AC01-86CE30844. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE87012279/JAW.

The Department of Energy's (DOE) Ocean Energy Technology (OET) Program is looking for cost-effective ways to harness ocean energy to help power tomorrow's world. Federally sponsored researchers are studying methods to transform the solar heat stored in the ocean's surface waters into electricity as well as new ways to convert wave energy into mechanical energy or electricity. This report provides a summary of research completed during FY 1986. Four major research areas are addressed in the work covered by this report: Thermodynamic Research and Analysis addresses the process and system analyses which provide the underlying understanding of physical effects which constitute the energy conversion processes, Experimental Verification and Testing provides confirmation of the analytical projections and empirical relationships, Materials and Structural Research addresses special materials compatibility issues related to operation in the sea. Much of its focus is on concepts for the system CWP which is a major technology cost driver, and Oceanographic, Environmental, and Geotechnical Research addresss those unique design requirements imposed by construction in steep slope coastal areas.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 18010, 18031, 18466

18047 (EUR—10249) Solar Energy R and D Programme, 1979-1984: Results and conclusions. Palz, W.; Grassi, G.; Steemers, T.C.; Pirrwitz, D.; Buis, H. (Commission of the European Communities, Brussels (Belgium)). Sep 1985. 82p. NTIS (US Sales Only), PC A05. Order Number DE88900347/JAW.

The Solar Energy R & D Programme described in this booklet was implemented through contracts between the Commission of the European Communities and private, public institutions and universities in the ten member countries of the EC. The total budget involved was approximately 110 million ECU of which 46 million ECU were contributed by the Commission. The overall duration of the program was from July 1979 to June 1983; as a rule, contracts started with about one year's delay and finished in many cases several months after the official end of the program. Projects described include solar thermal, distributed collector, and photovoltaic applications.

18048 (FRCEA-TH—41) Description of an experimental method for the characterization of the thermal performances of residential passive solar components. Rozmiarek, F. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France); Paris-7 Univ., 75 (France)). Jun 1987. 250p. (In French). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88752151/JAW.

The experimental solar test facility installed at the CEN in Cadarache (France) is described. The supporting systems and measuring instruments and processes for the characterization of various passive solar elements (Trombe walls, windows,...) are presented. A mathematical model of the thermal behaviour of the bench have been developed and the data processing calculations are analysed and verified with other methods. The principal objective of this test bench is to allow rapid evaluation and qualification of commercial passive solar components.

18049 (EUR—11056) Testing of passive solar components using identification methods. Hammarsten, S.; Van Hattem, D.; Bloem, H.; Colombo, R. (Statens Inst. foer Byggnadsforskning, Gaevle (Sweden); Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1987. 47p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900312/JAW.

Numerous full scale experiments have been performed in buildings with passive solar designs. The results from these experiments are ambiguous however, due to the great number of parameters that affect the final results. Work on simple test cells has therefore received increasing attention. With this approach the number of parameters can be kept small. Test cells can also be used for the testing of passive solar components, which represents an important field of interest, for technical and commercial reasons. The experiments presented here are part of an activity which aims at the development of test procedures for passive solar components under outdoor conditions.

18050 (NP—8770039, pp 188-199) Development of solar system technology for industry. Fixed heat process system. Goto, Hiroshi. (Kawasaki Heavy Industries, Ltd., Kobe, Japan). 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

The construction of a solar thermal constant-temperature warehouse was completed in September, 1983, followed by test operation and operation for adjustment using simulated load. Operation with real load was started in June, 1984. The operation for study ended in December, 1985. The warehouse has a capacity of 966 volume tons. Its principal equipment includes a flat plate type solar collector integral to the roof (682 m^2), a solar thermal absorption chiller (32,000 kcal/h x 1 unit), solar thermal dry type dehumidifiers (3 kg/h x 2 units), and a thermal stratification type thermal energy storage tank (75 m^3 x 1 unit). The technical results of the study are as follows: The absorption chiller has proved to be applicable to solar thermal fixed heat process type systems; the heat collecting capability and durability of the solar collector and the temperature holding capability and durability of the thermal energy storage tank have been confirmed; the solar percent of the entire system over two years has reached 83.4%. As an economic index of the system, the equipment capacity at which the depreciation term of the solar heat related equipment is minimized has been calculated using simulation. The results have revealed that a solar collector area of about 510 m^2 and a heat storage tank capacity of 50 m^3 are optimal. The constructed warehouse meets these capacities. (6 figs, 4 tabs)

18051 (NP—8770046, pp 619-626) Development of fixed heat process type system. Constant temperature warehouse system. Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is the final year report concerning the development of a system of the stable and effective application of solar energy to a constant temperature warehouse which is selected as a typical industrial production process always requiring the temperature control at a fixed level. 1. Operational study on a constant temperature warehouse system; Following the previous year, the warehouse storing actually dried mushroom (Shiitake) was operated, and data collection, system analysis and evaluation were conducted. As the results, an annual solar power dependability of 83.4% was obtained exceeding the target value of 70%. 2. System analysis and improvement of simulation program; The simulation was performed throughout the year to revise the program. Also, items to be taken

into consideration in developing simulation programs in the future were collected. Further, a study was made on an ideal model of which the solar heat dependability is more than 60%, the construction cost is low and the depreciation period is short. (3 figs, 3 tabs)

18052 (NP—8770046, pp 627-632) **Development of fixed heat process type system. Development of air heating type drying system.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is a report on the development of an air heating type solar system through the examination of the effective form of heat collecting units of carbon fiber collectors and its high performance as a system. (1) As heat collection test apparatuses, simple type collectors with a 6 - 7 m^2 scale each and aggregation type collectors with a size of 12 m^2 each were experimentally manufactured and tested. (2) An optimum heat collecting system was examined to confirm that the sectional form of the collector with 150 - 200 mm depth is most suitable for the collector and that a gable shape is effective for a CF screen. (3) From results of the heat transfer analysis, it was clarified that the above-mentioned gable type screen performs heat transer effectively. (4) A basic structure of the collector to be developed with gable type screens was decided and the perfomance evaluation thereof was conducted with the result exceeding the target collecting efficiency of 50%. (5) Timber drying tests were carried out to complete a basic design of a timber drying system with a drying capacity of 11 m^3/room and with collector size of 100 - 120 m^2. (7 figs)

18053 (NP—8770046, pp 633-640) **Development of advanced heat process type system. Development of freezing system of high capabilities.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is a report of the studies in 1985 on the development of absorption chiller and solar collector to cool warehouse to the temperature range of 0 - 5 'C with the objective of establishing the most adaptable system of cold storage house in order to enlarge the utilization scope of constant temperature warehouse. (1) Element design; The absorption chiller made in 1984 was operated and useful data were obtained. Afterward the chiller was modified to a high temperature water type. As for the solar collector, a sample of low cost type and connecting parts were experimentally manufactured and the superiority of the silver ion plating process was confirmed. As for the chiller tank system, experiments were made by a bench plant and the data of the relation between take out efficiency and brine rate. (2) Total system design; On the basis of the already obtained basic design, the total system design was made. Concerning the construction location, Kitanakagusuku Village in Okinawa Prefecture was selected. The storage temperature of the cold storage house and objects to be stored therein, and the specifications of unit cooler, solar heat collector and auxiliary heat source were determined. The measurement system design and the correction of the simulation programs were also made. (6 figs, 1 tab)

18054 (NP—8770046, pp 641-648) **Development of advanced heat process type system. Development of solar thermal conversion system for high temperature domain.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is a report of studies in 1985 in order to decide the specifications of the light weight and low cost version which is to be developed from the basic type system without reducing its capabilities. (1) Development of high temperature solar collectors of low cost type; As for the experimental manufacture of mass production type mirror panels, the selection of low cost materias and structure, the developments of the elements of the panel manufacturing method, the measuring method of the solar ray concentration efficiency, and the endurance test were made and the data were obtained. As for the design and experimental manufacture of the absorber, the most adaptable structure was investigated and the problems were solved. As for persuing and driving apparatuses, a persuing apparatus was designed and parts of the driving mechanism were selected. By manufacturing a high temperature solar collector experimentally, the data about assembling a collector were obtained. Thanks for these results, both weight and cost were reduced up about one half of the basic type collector. (2) The investigation of its adaptability to the solar system; Based upon statistical data, types of industries and processes to which the system is applicable, were conjectured and the demands for substitution of boilers in the fields connected were estimated semi-quantitatively. Also the effects of the inclined installation of segment mirror type solar collectors and the prevention of heat loss of the steam utilization system were investigated technically and the relevant data were obtained. (3 figs)

18055 (NP—8770046, pp 649-658) **Development of long term thermal energy storage system. Development of underground thermal energy storage system.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is a report of studies in 1985 in order to establish an economical construction method of a vertical underground heat storage tank constructed in the earth and to develop a system which can store surplus heat effectively during a fixed term. (1) Studies on the most adaptable underground heat storage tanks; The thermal diffusion model to calculate water temperature distribution inside a water tank and thermal conductivity model from the water tank to the earth were logically analyzed. Besides by simulation the experimentally measured data were compared to the logically computed data and their approximate coincidence was confirmed. (2) Long term heat storage experiments of cylindrical type heat storage tanks; By measurements with use of hume pipes, the characteristics of under ground heat storage tanks without thermal isolation were confirmed. (3) Experiments of latent heat storage materials; The experiments were made by suspending eutectic crystal magnesium salt in a vessel made of polypropylene, and useful data were obtained. (4) Feasibility studies of underground heat storage tanks; The conceptual design of the construction and operation of a large scale underground heat storage tank and the estimation of the equipment cost of a verifying plant were made and the economy and capability were estimated quantitatively. (5 figures, 1 tab)

18056 (NP—8770046, pp 659-669) **Development of long term thermal energy storage system. Development of long term thermal energy storage system utilizing chemical reaction heat.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is a report of studies in 1985 on the bench scale class long term heat storage tank utilizing the heat of reaction using metal hydride as thermal energy storage material in order to develop technology for practical use of solar systems for industries, etc.. (1) Thermal energy storage material; Selection of the particular kind of metal hydride for heat storage tanks and selection of the particular kind of material for heat pump functions were investigated. By analyzing the results of the operations of the primary and secondary experimentally manufactured heat storage tanks, combinations of suitable alloys were selected. (2) Thermal energy storage tank; By applying the obtained adaptive operating conditions of heat pumps to the secondary experimentally manufactured tank, its operation, measurement, and evaluation were made, and, based upon the analytical results. The final design of a bench scale class heat storage tank and the conceptual design and simulation of a heat storage tank for the practical use were made. Also the tank was operated in heat pump mode and the results were evaluated. (3) Controlling method; As the result of the investigation of the feedback control system which is operated by the flow rate of hydrogen, automatically controlled operations which enable heat output from a thermal energy storage tank using metal hydride, became possible and the control technology of the whole heat storage system was established. (5 figs)

18057 **Thermal storage in direct-gain buildings: The effective heat capacity and a generalized solar load ratio correlation.** Wray, W.; Best, E. (Los Alamos National Lab., Los Alamos, NM 87545). *Passive Solar Journal;* 4: No. 1, 41-62(1987).

A generalized solar load ratio correlation has been developed for direct-gain buildings by generating relationships between

the correlation parameters and two fundamental design parameters. The fundamental design parameters are the steady-state conductance of the solar aperture (U/sub c/) and the effective heat capacity of the building (EHC). EHC is a single parameter that may be used to characterize a variety of mass configurations and types. As such, EHC provides a measure of the amount of heat that may be stored one day and returned to the room air on the same day or on succeeding days at times and rates that lead to improvements in the long-term energy savings. A mathematical expression for EHC was developed by fitting performance results from a large matrix of detailed thermal network calculations. The generalized direct-gain correlation enables the designer to estimate the performance of any direct-gain building for which he knows the values of U/sub c/ and EHC, provided the values lie within the ranges treated in this paper. Because U/sub c/ and EHC may both be evaluated in terms of other more detailed design characteristics, the new correlation should be very useful.

18058 (NP—8770046, pp 610-618) **Technological development of utilization of solar system for industrial use. Development of cascading heat process type system.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is a report on the development of a cascading heat process utilizing solar energy to a process system making use of hot water with plural temperature levels. In this study, a solar system was installed for a yarn dyeing process of the textile industry to develop an optimum energy system. Also, as for the design method to design other new cascading heat process type system, examination and evaluation were conducted. The main items of the study include the following. 1. Development of heat collection technology with excellent performance. A durability test of a solar collector for high temperature was executed and also a heat pipe using PP5 in place of water was developed. 2. Development of an optimum control technology. An improvement of an experimental system, validation of the cascade control for medium and low temperature and an examination of the utilization system were carried out. 3. Operation and evaluation of a plant. Analysis and improvement of radiation loss was performed and heat loss was reduced to 56% of that before the improvement. Also, the operation data was analyzed. (6 figs, 3 tabs)

18059 (PB—88-128475/XAB) **Integral solar-water-heater demonstration project: the technological aspects. Special report.** McLean, D.I. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Building Research Inst.). 1986. 77p. (CSIR-NBRI-SR-BOU—82). NTIS, PC E06/MF E06.

North American Continent sales only.

The project was conceived with three goals in mind: to test the viability, cost effectiveness, and durability of integral solar-hot-water systems, in the low-income urban sector of the community; to demonstrate the use of integral solar water heaters; to provide information for the decision maker on, among other things, their utilization, cost, benefits and conservation potential. Although the project clearly had a strong influence on the attitudes of the occupants of houses with solar water heaters and of their immediate friends and neighbors, it is not possible to judge whether there has been any progress in the promotion of the use of solar energy. The initial outlay is at present beyond the means of these lower-income groups and only extended repayment periods at low interest rates will change the position.

18060 (DOE/SF/12221—T8) **Photolytic formation of free radicals and their effect on hydrocarbon pyrolysis chemistry in a concentrated solar environment: Final report.** Hunjan, M.; Mok, W.S.; Antal, M.J. Jr. (Hawaii Univ., Honolulu (USA). Renewable Resources Research Lab.). [1987]. Contract AC03-84SF12221. 133p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88004129/JAW.

The objective of this research was two-fold: (1) to determine whether uv photons available in a concentrated solar environment can be used as a photolytic source to dissociate vapor phase acetone; and (2) to explore the effects of photolysis on rate and selectivity of free radical reactions. The experiments were conducted in a 1 kW arc image furnace/tubular flow reactor system. The results obtained conclusively showed that acetone readily photodissociates in a 1000 sun environment, leading to the formation of free radicals. It was further observed that Beer-Lambert law can be used to predict the rate of photolysis of acetone. Furthermore, acetone, when used as source of methyl radicals, sensitized the reaction chemistry of alkanes and alkenes at a temperature of 350°C. The methyl radicals from photolysis of acetone enhanced the cracking reactions of the alkanes yielding smaller alkanes and alkenes. When the initial hydrocarbon reactant was an alkene, a sensitization of the addition reaction was observed leading to formation of next higher alkene. To gain a theoretical insight into the reaction chemistry of alkanes, a numerical simulation model was developed to study the photosensitized decomposition of n-butane and the simulation results thus obtained were found to be in close agreement with experimental results. 64 refs., 10 figs., 22 tabs.

18061 (EUR—11234) **23 solar-heated swimming-pools in France: Demonstration project: Final report.** Corroller, P. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1987. 93p. (In French and English). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88900397/JAW.

The energy consumption level of swimming-pools in France reaches a total of 400,000 t.o.e., shared out between open-air pools (100,000 t.o.e.) and covered pools (300,000 t.o.e.). This situation led contractors and public authorities to examine the various energy-saving technologies available. Among them, the use of solar collectors combined with a system for covering the surface of the water, proved to be an interesting technical and economical proposition. In order to demonstrate the system's profitability, the AFME set up a program to promote the solarization of swimming-pools on a significant scale, with the financial support of the CEC. 4 covered pools and 19 open-air pools were equipped in this way throughout the whole of France. The geographical distribution of these installations, and the diversity of the technologies employed, constitute the unique aspect of the program.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 17984

18062 (DOE/SF/15293—T1) **The feasibility of a fluidized bed solar collector using low density particles: Final report, October 1, 1984-January 31, 1987.** Azzola, J.H.; Glicksman, L.R.; Modlin, J.M. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Mechanical Engineering). 31 Jan 1987. Contract AC03-84SF15293. 201p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88005016/JAW.

An air fluidized bed, contained in the wall cavity of an exterior building wall, serves as the basis of a new solar collector design which is simpler than a water-cooled collector and has a thermal performance on a par with an air-cooled collector. The fluidized bed serves as an intermediate heat transfer loop transferring diffuse solar energy absorbed on the external building surface to a liquid thermal transfer loop. Such devices yield heat transfer coefficients an order of magnitude higher than single phase air flow. In this application, low density particles are used to minimize fan power. When the bed is defluidized, it acts as a good thermal insulator. Recent low density experimental results are presented for the heat transfer coefficients to immersed tubes and bounding walls and the effective conductivity through the bed in order to predict overall the performance of the fluidized bed solar collector (FBSC). A full scale FBSC is constructed, tested and the results presented and compared with the predictions based on the composite of previous results. 41 refs., 32 figs., 24 tabs.

18063 (EUR—10906) **A five year weathering experiment with solar collectors.** Bauch, R.; Brovelli, M.; Weisgerber, P. (eds.). (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1987. 16p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900369/JAW.

Two solar collectors were exposed for five years in a weathering experiment, keeping the maximum temperature under solar irradiation limited by simple thermoregulated heat exchange circuits

in order to simulate real user conditions. The installation used was a prototype for operational tests, and preceeded another experiment of the same type, which is still running in two zones of different environment regarding corrosivity of the atmosphere, for the study of atmospheric corrosion and degradation. Observations made during operation and the results are given of the examinations of the collectors after five year's exposure. 4 refs., 9 figs.

18064 **(SAND—87-7014) Point-focus concentrator reflector assembly: Phase 1.** (Solar Kinetics, Inc., Dallas, TX (USA)). Nov 1987. Contract AC04-76DP00789. 153p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88003616/JAW.

A point-focus concentrator reflective assembly was developed in Phase I on contract 21-3695 under the direction of Sandia National Laboratories, Albuquerque. This concentrator is conventonal in presentation, yet innovative in detail. The development concentrated on structural efficiency and production design to achieve a high performance at minimum cost. The concentrator design achievs stiffness and strength through the integration of two structural elements. The optical element provides the reflective surface accuracy; a secondary support structure provides resistance to uniform and non-uniform load conditions. A retractable receiver strut, which moves the power conversion assembly out of focus in emergency power loss, was also incorporated. This same assembly provides maintanance access to the engine near ground level. A full-scale optical element was fabricated. Slope error was measured at 1 mrad. Concentrator performance was projected to be 88%, optical. This point-focus concentrator reflector assembly design provides low weight, low cost, and simplicity. Our analysis indicates these benefits are gained without impairing performance. 7 refs., 44 figs., 10 tabs.

18065 **Exposure testing of solar absorber surfaces.** Moore, S.W. (Los Alamos National Lab., NM, USA). *Solar Energy Materials;* **16**: No. 5, 453-466(Nov 1987). (CONF-8608214—).

From Materials and optics for solar energy conversion and advanced lighting technology conference; San Diego, CA, USA (19 Aug 1986).

The Los Alamos National Laboratory has been involved in supporting, monitoring and conducting exposure testing of solar materials for approximately ten years. The Laboratory has provided technical monitoring of the IITRI, DSET, Lockheed, and Berry contracts and has operated the Los Alamos Exposure Facility for over five years. This report will outline some of the past exposure testing, the testing still in progress, and describe some of the major findings. While this report will primarily emphasize solar absorber surfaces, some of the significant findings relative to advanced glazing will be discussed.

18066 **Analysis of steam injected gas turbines for solar thermal applications.** Linker, K.L. (Solar Distributed Receiver Div., Sandia National Labs., Albuquerque, NM). pp 1337-1342 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—). Contract AC04-76DP00789.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879013.

The Department of Energy's (DOE) Solar Thermal Program has as one of its program elements the development and evaluation of heat engine technologies which are applicable to Distributed Receiver Systems. The primary research and development activities, for the past several years, have involved the so-called dish-electric concept in which a heat engine, solar receiver, and generator are combined as a Power Conversion Assembly (PCA) and mounted at the focus of a parabolic dish concentrator. PCA's based on Rankine, Brayton, and Stirling cycle heat engines have been designed and built at 10-25 kWe power levels with varying degrees of success. The small Brayton cycle engines in particular have fallen short of expectations as a focal mounted PCA. This report analyzes larger Brayton engines (500 kWe and above) supplied with fossil energy and solar energy from an array of 15 m diameter parabolic dishes or small central receivers. In particular, a steam injected gas turbine (STIG) cycle is examined because of its ability to offer high efficiencies. This report outlines quantitatively the cycle parameters which effect efficiency for a solar augmented steam injected gas turbine.

18067 **Advances in concentrator technology.** Boes, E.; Maish, A. (Sandia National Labs., Albuquerque, NM). pp 985-992 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

This presentation discusses the numerous significant advances which have been made in photovoltaic concentrator development in the past 18 months. These advances have important performance, cost and reliability implications for concentrator technology in both the near-term and the more distant future. With these advances and continued development, PV concentrator module prices of $1 per peak watt can probably be achieved within several years. Thus, PV concentrators represent a very attractive collector option for large PV power systems in the near future.

18068 **The role of base electric field in enhancing the superlinearity in Si concentrator cells.** Zirkle, T.E.; Backus, C.E.; Schroder, D.K. (Engineering Research Center, Arizona State Univ., Tempe, AZ 85287). pp 1368-1373 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Analysis of superlinear characteristics of short-circuit current with irradiances above 1 sun for Si concentrator cells have shown the importance of the base electric field in enhancing the collection efficiency of those minority carriers generated in the base. The effect of the base electric field can be incorporated into effective upstream and downstream diffusion lengths. In one case the effective downstream diffusion length increases from 223 μm at one sun to near 1000 μm at 1000 suns. Collection of minority carriers in the base alone due to the enhanced diffusion lengths is sufficient to result in the observed superlinearity. Superlinearity varies significantly with base resistivity and base thickness. Due to the increased collection of minority carriers, efficiencies of planar junction, low resistivity Si concentrator cells may be understated by nearly 10%.

18069 **Hot-spot qualification testing of concentrator modules.** Gonzalez, C.C.; Sugimura, R.S.; Ross, R.G. Jr. (Jet Propulsion Lab., California Institute of Technology, Pasadena, CA 91109). pp 1416-1423 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Results of a study to determine the hot-spot susceptibility of concentrator cells, to provide a hot-spot qualification test for concentrator modules, and to provide guidelines for reducing hot-spot susceptibility are presented. Hot-spot heating occurs in a photovoltaic module when the short-circuit current of a cell is lower than the string operating current forcing the cell into reverse bias with a concurrent power dissipation. Although the basis for the concentrator-module hot-spot qualification test is the test developed for flat-plate modules, issues, such as providing cell illumination, introduce additional complexities into the testing procedure. The same general guidelines apply for protecting concentrator modules from hot-spot stressing as apply to flat-plate modules. Therefore, recommendations are made on the number of bypass diodes required per given number of series cells per module or source circuit. In addition, a new method for determining the cell temperature in the laboratory or in the field is discussed.

18070 **A technique for soldering GaAs concentrator solar cells.** Ruby, D.S. (Sandia National Labs., Albuquerque, NM 87185). pp 1502-1503 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

A technique has been developed for soldering GaAs concentrator solar cells to other module components without causing any degradation in cell performance. The method avoids the use of liquid flux and instead relies on the reactive properties of HCl gas to clean the metal surfaces prior to soldering. The soldering is then done in a reducing atmosphere of H/sub 2/ to prevent oxidation of the metals at the elevated soldering temperatures. This approach has been found to result in mounted cell efficiencies that equal or exceed those that were measured before soldering.

18071 **Measured performance of ENTECH's crossed lens photovoltaic concentrator.** McDanal, A.J. (ENTECH, Inc., DFW Airport, TX). pp 1234-1238 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—).

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Over the past several years, ENTECH has been developing a patented, optical concentrator concept called the crossed lens concentrator. Detailed design studies and analytical performance analyses conducted on this optical concept have resulted in the development of two types of photovoltaic concentrator modules: a 160X crossed lens module which uses advanced silicon cells and a 500X crossed lens module which uses gallium arsenide (GaAs) cells. An innovative prismatic cell cover has been developed which completely eliminates gridline obscuration losses on the photovoltaic cell. A cell cover has been fabricated and tested which will allow 55% of the cell's active area to be obscured by gridlines. Designs for the 160X silicon cell and the 500X GaAs cell have been generated and are currently being fabricated by Solarex and ASEC, respectively, for use with the new cell cover. Both module designs are described and recent test results are presented.

1420 Heat Storage

REFER ALSO TO CITATION(S) 18009, 18055, 18056, 18440

15 GEOTHERMAL ENERGY

REFER ALSO TO CITATION(S) 17654, 17915

18072 (NP—8770039, pp 219-231) **Outline of the geothermal energy development.** Takebayashi, Yoichi. (New Energy Development Organization, Tokyo, Japan). 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

This paper gives a comprehensive report on the geothermal energy development division in NEDO. Two units belong to this division: the Geothermal Survey Department and the Geothermal Technology Development Office. The Geothermal Survey Department performs survey concerning the presence of geothermal resources, assessment of the influence of geothermal energy development on environment, establishment of new exploration technology for usable deep geothermal energy resources, development of geothermal reservoir evaluation techniques aimed to develop techniques for estimating the appropriate scale of power generation in the development area, and liability guarantee for geothermal energy development funds. The Geothermal Technology Development Office performs research and development of new various technologies, including those for binary-cycle power generation plants which can make full use of hydrothermal resources affluently present in Japan, research and development of collection and injection systems which can utilize non-volcanic hydrothermal resources present deep underground around urban areas for hot-water supply and heating services in local communities, and technical development of power generation systems utilizing hot dry rock. The number of areas in which development has started is 21. The budgets assigned to these two units are as follows: 13.2 billion yen for fiscal 1985 and 12.108 billion yen for fiscal 1986 assigned to the Geothermal Survey Department; 2.11 billion yen for fiscal 1985 and 2.61 billion yen for fiscal 1987 assigned to the Geothermal Technology Development Office. (3 tabs)

1501 Resource Status And Assessment

18073 **(SAND—87-2560C) Status of the Magma Energy Project.** Dunn, J.C. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-880103—3). NTIS, PC A02. Order Number DE88002413/JAW.

From Symposium on geothermal energy; New Orleans, LA, USA (10 Jan 1988).

The current magma energy project is assessing the engineering feasibility of extracting thermal energy directly from crustal magma bodies. The estimated size of the US resource (50,000 to 500,000 quads) suggests a considerable potential impact on future power generation. In a previous seven-year study, we concluded that there are no insurmountable barriers that would invalidate the magma energy concept. Several concepts for drilling, energy extraction, and materials survivability were successfully demonstrated in Kilauea Iki lava lake, Hawaii. The present program is addressing the engineering design problems associated with accessing magma bodies and extracting thermal energy for power generation. The normal stages for development of a geothermal resource are being investigated: exploration, drilling and completions, production, and surface power plant design. Current status of the engineering program and future plans are described. 20 refs., 12 figs.

18074 (NP—8770039, pp 232-268) **Survey for promoting geothermal energy development.** Kawamura, Masakazu. (New Energy Development Organization, Tokyo, Japan). 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

Since fiscal 1980, NEDO has been conducting geothermal energy development promoting survey on areas with potential geothermal resources to investigate the presence of resources and the influence of development on environment. The purpose of the survey is to encourage private corporations to start full-scale survey and development, thus contributing to the development of geothermal power generation. A unit period of survey for each area is 3 years. This survey has started in 21 areas. For each of the 18 areas in which at least the first-year survey ended, this paper reports an outline of the area, the survey items, and the results of the survey. The areas reported are as follows: East Hachimantai, Dozan River Downstream area, Kurino-Tearai, Iburi, Okiura, West Teshikage, Yuzawa-Okatsu, Okuaizu, Shimokita, North Azuma, Ikeda Lake surroundings, Toyou, Minamikayabe, Yuda, West Unzen, Kamikawa, Tamataki, and Kuzumi. The paper also reports the development of techniques for evaluating geothermal reservoirs. This development was performed for the 4 years from 1984 to 1988. Its activities were focused on four targets: the development of a simulator, well survery, conceptual design of simple medium to small-scale geothermal power generation systems and their evaluation, and the excavation of 1500 m class observation wells. The excavation of observation wells and the well survey were performed in the Kirishima and Sumikawa areas. (22 figs)

18075 (NP—8770039, pp 269-293) **Comprehensive survey of geothermal resources over Japan (secondary survey).** Tamao, Shiro. (New Energy Development Organization, Tokyo, Japan). 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

On the basis of the results of the primary survey from 1980 to 1983, the secondary survey was conducted on areas with potential geothermal resources. These areas are divided into two categories: areas characterized by the hydrothermal convection system related to young igneous intrusion -- i.e., the Niseko area in Hokkaido, Kokubu area over Kagoshima and Miyazaki Prefectures, and Hakkoda area over Aomori and Akita Prefectures -- and areas characterized by high-temperature potentiality -- i.e., the Minamiaizu area over Fukushima and Tochigi Prefectures. The survey

was performed from 1984 to 1986. The survey items are as follows: geothermal geologic chart drawing, investigation of volcanic rock distribution and chronology, precision gravity prospecting, resistivity investigation, geological structure investigation using the teleseismic P wave delay method, thermal radiation survey, and analysis and evaluation. The thermal source, structure of geothermal reservoirs, and fluidity of geothermal fluid were evaluated. The results of total evaluation have shown that the potentiality of the Niseko and Hakkoda areas is high, that of the Kokubu area is medium, and that of Okuaizu area is low. In addition, the present state and tendency of geothermal energy development in the US were investigated to evaluate the resources there. From 1984 to 1985, a system for evaluating thermal sources was developed. (12 figs, 5 tabs)

18076 (NP—8770044, pp 242-262) **Survey the promotion of geothermal resources development.** Yoshida, Fujio. (New Energy Development Organization, Tokyo, Japan). 21 Sep 1984. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

In Proceedings of parallel sessions for the 4th NEDO general assembly.

These surveys are on geothermal resources and its environments which NEDO started in 1980. During the period of 5 years until 1984, the surveys of the following 8 areas were completed: the eastern part of Hachimantai, Iwate Prefecture; the lower reaches of Dozan River, Yamagata Prefecture; Kurino. Tearai, Kagoshima Prefecture; Iburi, Hokkaido; Okiura, Aomori Prefecture; the western part of Teshikaga, Hokkaido; Yuzawaokachi, Akita Prefecture; and Okuaizu, Fukushima Prefecture. at present, 3 areas (Shimokita, Aomori Prefecture; the northern part of Azuma, Yamagata Prefecture; and around Lake Ikeda, Kagoshima Prefecture) are under survey. At the Kurino area, the amount of ejected water is big and the following extremely favorable results were obtained; gushing steam-6.1 to 18.1 t/h, gushing hot water- 1.8 to 32.8 t/h and the end pressure upon closure of testbores- 19.5-21 kg/cm^2. At the Yuzawaokachi area, gushing tests showed the results of steam- about 11 t/h, hot water- 6 t/h and the end pressure upon closure of testbores- 33 kg/cm^2. At the Okuaizu area, steam- 0.7 to 5.7 t/h, hot water- 1.0 to 5.5 t/h and the end pressure upon closure of testbores- 17 to 22 kg/cm^2 and at the Okiura area, steam- 0.6 t/h and hot water- 12 t/h were obtained respectively. At other areas, however, no worthy results were shown. (11 figs)

18077 (NP—8770044, pp 263-284) **Comprehensive survey of geothermal resources in Japan.** Takagi, Shinichiro. (New Energy Development Organization, Tokyo, Japan). 21 Sep 1984. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

In Proceedings of parallel sessions for the 4th NEDO general assembly.

This survey was started by NEDO as a 4 year project in 1980. In 1983, Curie surveys, gravity surveys and assessment of promising areas for geothermal resources in Japan were carried out. Furthermore the assessment criteria for promising geothermal areas were prepared in the following three types of geothermal resources: 1) Volcanic hot water convection area; Depths of Curie points are shallow on the side of the Fossa Magna, which is on the east side of the fault-line running between Itoigawa and Shizuoka, and deep in the area of distribution of Paleocene basic rocks on the west side of the line above. In the areas where radar image breakage density is large (Niseko, Akita Komagatake and its surroundings, the northern part of Zao-Funagata), hot water activities are expected. The most of other extracted areas are areas covered by lava of the recent Quaternary period and/or deposit of ejecta flow and their lineament density is small. 2) Deep hot water area; 55 areas are counted in which a great majority of the known deep hot water areas are included. 3) High temperature potential area; The criterion that an area within the radius of 5 km from a hot spring of more than 90'C was newly provided. It means a geothermal area of high temperature. (13 figs, 2 tabs)

18078 (NP—8770045, pp 237-264) **Survey for the promotion of geothermal resources development.** Kawamura, Masakazu. (New Energy Development Organization, Tokyo, Japan). 20 Sep 1985. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

In Proceedings of parallel sessions for the 5th NEDO general assembly.

This is a report for 1985 for NEDO contracted project. A pilot survey was made for the prospective geothermal area where no private enterprises had ever endeavoured. East Hachimantai: 0.02 t/h steam and 0.2 t/h hot water only. Down stream of Dozangawa: No potential escaping water layer was not found down to the depth of 1,800 m. Kurino-Chozu: Quite potential with 18.1 t/h steam and 32.8 t/h hot water. Northwestern Iburi: Only 136.9 'C. Okinoura: 0.6 t/h steam and 12 t/h hot water. Western Teshikaga: No hot water zone (above 200 'C) down to 1,800 m depth. Yuzawa-Okachi: 11 t/h steam and 6 t/h hot water. Oku-Aizu: 5.7 t/h steam and 5.5 t/h hot water. Shimokita: 3.4 t/h steam and 9.3 t/h hot water. Northern Azuma: 182.2 'C at 1,300 m depth. Lake Ikeda and surroundings: No blow out down to 1,150 m depth. Toyoha: 309 'C at 1,500 m depth. Minami-Kayabe: 173.6 'C at 1,200 m depth. Yuda: 158.7 'C at 1,500 m depth. Western Unzen: 248.4 'C at 1,000 m depth. (15 figs)

18079 (NP—8770046, pp 822-853) **Comprehensive survey of nationalwide geothermal resources.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is a report on the general survey on the Japanese geothermal resources wherein an extraction/selection of the prospective areas was made as well as to establish an up-to-date sensing technology. In the first four years, examination was made by utilizing such methods as remote-sensing (radar, Landsat), Curie point method and gravitational method. The result was reflected in an evaluation and extracting standard of national prospective geothermal areas. In 1982, 17 maps of prospective Kyushu areas and 2 sectional maps were issued. In 1983, 93 maps of prospective areas except Kyushu and 30 sectional maps were prepared. Since 1984, the survey shifted to the surface study and comprehensive analysis rather than the remote sensing study. By picking up 4 representative districts out of the abovementioned areas, survey was made on the distribution of the volcano rocks as well as their age, geochemical study of fluids, precise gravitational survey, specific resistance study, and survey on heat dispersion, etc.. In 1985, based on the conceptual design of the heat-source evaluation system made in the previous year, and also based on the study of the four districts and the U.S. situation, a flow chart on the evaluation methodology was developed. It was found possible to evaluate using the ground surface data rather than by the underground data on wells.

18080 (NP—8770046, pp 854-866) **Survey for the promotion geothermal resources development.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

NEDO started an introductory survey for geothermal resources development in 1980. This survey was intended to continue for three years: the first year is for surface geology, geo-chemical survey, physical survey, and structural boring survey; the second year is for physical survey and precise boring survey; the third year is for physical survey and environmental boring survey, and for the comprehensive study. The second year survey was made in 1985 in four districts of Toyoha, Minami-Kayabe, Yuda and Unzen-Seibu, and data on the breadth of the high temperature region were acquired. The first year survey was carried out in three districts of Kamikawa, Tamataki and Kuju, and data were obtained on the inclination of ground temperature distribution and the maximum temperature.

18081 (NP—8770046, pp 867-872) **Survey for the promotion of geothermal resources development. Development of evaluation of geothermal reservoir layer.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is an annual report (1985) for NEDO project which was started in 1984 for the rational estimation of the production capacity and optimum power generation scale by properly evaluating the geothermal reservoir layer. Concerning a three-dimensional gas-thermal reservoir and a two-phased flow within the well data were

amended of the incomplete data of the previous year and were improved and expanded for a more easily applicable simulator. Another simulator was made for the two-phase (hot water and steam) three-dimensional reservoir by applying and expanding the above-mentioned formulation to the two-phase state. In the two model districts, Kirishima and Sumikawa, an observation well of 1,500 m depth was drilled at a location with less reservoir data. Water injection test and pressure interference test were carried out for obtaining a wide distribution of the infiltrating water within the reservoir. Concerning the Kirishima district, a conceptual model of geo-thermal structure was prepared on the basis of the data of the previous year, and a simulation was carried out by establishing a parameter for the reservoir layer in order to prepare a quantitative model of the natural condition. Concerning the Sumikawa district, preparation was made for the simulation analysis in the succeeding year by collecting the existing data.

18082 (NP—8770046, pp 873-908) **Verification study on geothermal exploration technology.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is an annual report for 1985 on the verification study on the estimation made by utilizing various sensing technology. Concerning the Sen-Gan district, one of the model district: (1) Two wells of 1500 m depth were drilled following the previous year. A pillar map and a contrasting geological map of the wells and a conceptual map of the geo-thermal system of the surveyed area were prepared based on the examination and analysis. (2) Four wells of 400 m depth were drilled. Analysis of the flow of heat was made and a model pillar map, and a map of geotemperature distribution at 0 m level were prepared. (3) Forty-five observation points were set over the entire area. Geo-magnetism and geo-current were examined, and a plan map of specific resistance, two-dimensional cross-sectional diagram, and an interpretation map from the MT data were prepared. (4) Analytical cross-sectional diagram of specific resistance was prepared from the data of electrical sensing to obtain a knowledge on the depressed structure. Concerning the Kurikoma district: Examination and analysis of a well of 1390 m depth drilled in the previous year was made, and model pillar diagram, contrasted geological diagram of wells, and cross-sectional diagram of the temperature distribution were prepared. Concerning the development of precise sensing technology of geo-magnetism and geo-current, a one-point MT method measuring equipment was trially made; a control program was developed and the equipment was confirmed of its normal performmance. Two measuring point double checking type data processing program and two-dimensional anlysis program were developed.

1502 Geology And Hydrology Of Geothermal Systems

18083 (LA-UR—88-159) **A comparison of two heat transfer models for estimating thermal drawdown in Hot Dry Rock reservoirs.** Robinson, B.A.; Kruger, P. (Los Alamos National Lab., NM (USA); Stanford Univ., CA (USA)). 1988. Contract W-7405-ENG-36. 9p. (CONF-880111—2). NTIS, PC A02. Order Number DE88005388/JAW.

From 13. workshop on geothermal reservoir engineering; Stanford, CA, USA (19 Jan 1988).

Estimates of thermal drawdown in Hot Dry Rock geothermal systems have been made with two different models of heat transfer from hydraulically fractured reservoir rock blocks to water circulated through the fracture permeability. One model is based on deconvolution of experimental tracer response curves into a network of flowpaths connected in parallel with heat transfer calculated individually in each flowpath. The second model is based on one-dimensional flow through the rock with a block size distribution described as a group of equivalent-radius spheres for which the heat transfer equations can be solved analytically. The two-models were applied to the planned Phase II long-term thermal drawdown experiment at Fenton Hill, NM. The results show good agreement between the two models, with estimates of temperature cooldown from 240°C to 150°C in a few years depending on selected operation parameters, but with somewhat differing cooldown curve characteristic shapes. Data from the long-term experiment will be helpful in improving the two models.

18084 (LA-UR—88-160) **Fracture network modeling of a Hot Dry Rock geothermal reservoir.** Robinson, B.A. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 9p. (CONF-880111—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005389/JAW.

From 13. workshop on geothermal reservoir engineering; Stanford, CA, USA (19 Jan 1988).

Fluid flow and tracer transport in a fractured Hot Dry Rock (HDR) geothermal reservoir are modeled using fracture network modeling techniques. The steady state pressure and flow fields are solved for a two-dimensional, interconnected network of fractures with no-flow outer boundaries and constant-pressure source and sink points to simulate wellbore-fracture intersections. The tracer response is simulated by particle tracking, which follows the progress of a representative sample of individual tracer molecules traveling through the network. Solute retardation due to matrix diffusion and sorption is handled easily with these particle tracking methods. Matrix diffusion is shown to have an important effect in many fractured geothermal reservoirs, including those in crystalline formations of relatively low matrix porosity. Pressure drop and tracer behavior are matched for a fractured HDR reservoir tested at Fenton Hill, NM.

18085 (LBL—23940) **Proceedings of the symposium on the Long Valley Caldera: A pre-drilling data review.** Goldstein, N.E. (ed.). (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 204p. (CONF-8703199—). NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88004885/JAW.

From Symposium on the Long Valley caldera: pre-drilling data review; Berkeley, CA, USA (17 Mar 1987).

This proceedings volume contains papers or abstracts of papers presented at a two-day symposium held at the Lawrence Berkeley Laboratory (LBL) on 17 and 18 March 1987. Speakers presented a large body of new scientific results and geologic-hydrogeloic interpretations for the Long Valley caldera. The talks and the discussions that followed focused on concepts and models for the present-day magmatic-hydrothermal system. Speakers at the symposium also addressed the topic of where to site future scientific drill holes in the caldera. Deep scientific drilling projects such as those being contemplated by the DOE Division of Geothermal Technology (DGT), under the Magma Energy Program, and by the DOE Office of Energy Research, Division of Engineering and Geosciences (DEG), along with the USGS and NSE, under the Continental Scientific Drilling Program (CSDP), will be major and expensive national undertakings. DOE/DEG is sponsoring a program of relatively shallow coreholes in the caldera, and DOE/DGT is considering the initiation of a multiphase program to drill a deep hole for geophysical observations and sampling of the "near magmatic" environment as early as FY 1988, depending on the DOE budget. Separate abstracts have been prepared for the individual papers.

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 18082, 18085, 19684

18086 (NP—8770045, pp 265-292) **Verification surveys of geothermal exploration technology.** Takagi, Shinichiro. (New Energy Development Organization, Tokyo, Japan). 20 Sep 1985. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

In Proceedings of parallel sessions for the 5th NEDO general assembly.

This is a report for 1985 for NEDO contracted project. At Sengan district, a survey was made on the geological structure and the geothermal reservoir by means of a seismic prospecting, electromagnetic method, electric prospecting, and heat flow survey, and a drilling of 1,500 m class well was started in the northern Yakeyama district surrounding the new volcano group (Tamagawa caldera). The northern area including Tamagawa Hot Springs and Goshogake Hot Springs were surveyed by an electromagnetic method to analyze the underground specific resistance structre. A balance with the highland hot springs area. was observed Kurikoma

district was surveyed for its geothermal structure by means of such methods as thermal image, method electric prospecting, and electromagnetic method. Well prospecting at Arayu district within Onikobe0caldera gave an well data valuable for investigating a geothermal reservoir structure, and a high-temperature reservoir was confirmed in the surrounding area of Katayama Jigoku and Takahyuga-yama. Area with low specific resistance (by an electromagnetic method) was distinctively found in the southern half of Onikobe caldera which indicated the existence of a geothermal reservoir structure. (8 figs, 1 tab)

18087 **(GB—112) Investigation of the geothermal potential of the UK: interpretation of a deep seismic reflection profile in the Glasgow area.** Penn, I.E.; Smith, I.F.; Holloway, S. (British Geological Survey, Keyworth. Geothermal Resources Programme). 1984. 18p. British Geological Survey, Keyworth, Nottinghamshire. Price Pound 2.70.

Some 16.25 line-km of reflection seismic data acquired by the vibroseis method to the north-east of Glasgow and recorded to 6.0 s two-way travel-time (TWTT) yields coherent reflections in the upper 1.0 s TWTT only. The upper 0.4 s TWTT may be interpreted in terms of the Namurian to Dinantian Upper Limestone Group to Lower Limestone Group sequence known from drilling. Below this level the section is interpreted on regional grounds to show some 180 m of Upper Sedimentary Group sediments thinning south-westwards to 140 m against a buried relief of Clyde Plateau Lavas. The latter are calculated as being c. 550 - 600 m thick and overlie Calciferous Sandstone Measures to Upper Old Red Sandstone sediments which thicken southwards from 300 m to 500 m. They thin to 400 m, however, farther to the south-west possibly by overlap of basal beds against a surface taken to mark the top of Lower Old Red Sandstone and subjacent strata.

18088 (NP—8770039, pp 294-318) **Development of precision technique of detecting geomagnetism and telluric current method.** Osawa, Satoshi. (New Energy Development Organization, Tokyo, Japan). 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

Geothermal prospecting method includes such several ways as geological surveying, geochemical surveying, and physical prospecting, etc. In this research, a method called MT method was developed as a physical prospecting method, which is effective for underground prospecting in geothermal areas. In this development, it was aimed to develop a portable, instantaneous, 4-measuring-point triple-reference processing and prospecting technique of MT method, because of the handicapped conditions of Japan such as mountainous topography and artificially noisy environment. In 1983, a conceptual design of the device was tried along with necessary data acquisition, etc. In 1985, a prototype of 1-measuring-point MT method was prepared, as well as its remote control processing system. In 1986, an instantaneous processing system is aimed at by a production of 2-measuring-point double-reference device and its field testing. This will lead the Japanese level of research to the world's top level, and it will even surpass it regarding the portability and quality control techniques. (18 figs, 9 tabs)

18089 **(NP—8770042) Source location and focal mechanism of AE event during the hydraulic fracturing.** Sasaki, Shunji; Ishida, Tsuyoshi; Kanagawa, Tadashi. (Central Research Inst. of Electric Power Industry, Abiko, Chiba (Japan)). Apr 1987. 36p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88770042/JAW.

A small scale hydraulic fracturing experiment was carried out to characterize the Acoustic Emission (AE) activity associated with the hydraulic fracture process. The results of the experiment are summarized as follows. (1) AE activity seems to depend on the increase of the flow rate. If flow rate was increased then AE activity was also increased. AE activity occurred remarkably when the fluid pressure reached the break down pressure. (2) The time history of the events was that they started at the borehole and migrated away. The orientation of fractures determined from AE mapping were consistent with those of the pre-existing natural joint (3) The hydrofractured planes in this experiment were created with shear fracture and propagated along pre-existing natural joints. (4) AE monitering can be used to define the geometry of the hydrofracture and provide useful information on the mechanism of hydroraulic fracturing. (23 figs, 2tabs, 11 refs)

18090 **(NP—8770043) Investigation on the geothermal history of the alteration zone by ESR dating method. Kurobe Babadani geothermal alteration zone.** Tanaka, Kazuhiro; Miyakawa, Kimio. (Central Research Inst. of Electric Power Industry, Abiko, Chiba (Japan)). Mar 1987. 27p. (In Japanese). NTIS (US Sales Only), PC A03. Order Number DE88770043/JAW.

Geothermal history of Kurobe Babadani geothermal alteration zone is investigated by Electron Spin Resonance (ESR) dating method,using quartz grains separated from alteration zones. The Babadani alteration zone is composed of quartzdiorite, terrace deposit, talus deposit and river bed deposit. From the results of ESR spectra and thermal annealing experiments, the thermal history of the Kurobe Babadani geothermal alteration zone is suggested as follows. First geothermal activity with acid-neutral occurred 10 cubed years order before at quartz diorite and have continued until quite recently. And then, at the time from 10 years order to 10 cubed years order before, second geothermal activity have extended in terrace deposits and have continued to recent. (12 figs, 11 refs)

18091 **(DOE/ID/12614—T1) Clackamas 4800-foot thermal gradient hole: Cascade geothermal drilling: Final technical report.** Iovenitti, J.L.; D'Olier, W.L. (Thermal Power Co., San Francisco, CA (USA)). 30 Sep 1987. Contract FC07-85ID12614. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88002704/JAW.

Thermal Power Company (Thermal) completed a thermal gradient hole to about 5000 feet (1524 m) total depth in Section 28, Township 8 South, Range 8 East, Willamette Meridian, Marion County, Oregon. The objective was to obtain data for the characterization of the deep hydrothermal regime in the Cascades volcanic region in order to better define its geothermal resource potential. The depth and location of the thermal gradient hole were designed by Thermal to test the basis of the Clackamas geothermal system exploration model developed by Chevron Resources Company.

1505 Economic And Financial Aspects

18092 **(SAND—87-2409) Potential impact of R and D on hydrothermal energy cost.** Traeger, R.K. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005493/JAW.

The potentital impact of the DOE/Geothermal Technology Development programs on the cost of geothermal power has been estimated using the computer program IMGEO.300. Results indicate a potential 30 to 40% cost reduction for hydrothermal systems with a 40 to 50% cost reduction potential for binary systems. The purpose of this document is to demonstrate the use of IMGEO. The initial results are tentative because the R and D goals have not been finalized and the code has not been completely validated.

1506 Environmental Aspects And Waste Disposal

REFER ALSO TO CITATION(S) 18102

18093 (NP—8770046, pp 788-796) **Development of geothermal hot water power generation plant. Development of binary cycle power generation plant; development of hydrogen sulfide removal technology.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is an annual report for 1985 on the study which started in 1977. The project deals with the high-rate recovery of H_2S from the geothermal power plant which is to be regenerated as a sulfur element. 1) From the result of the highly concentrated condensate water treatment test in an cooling pilot plant, a spray tower seems

more suitable than the leaking tray method from the viewpoint of pressure loss and scale adhesion, although the efficiency is lower. 2) A continuous test operation of RET pilot plant wherein 3 types of H_2S concentration (6%, 0.8%, 1500 ppm) were tested, indicated the possibility of attaining more than 90% efficiency of H_2S removal. 3) Dismantling examination of the pilot plant disclosed a round erosion on a part of the cooling tower pipings. Corrosion was found, in RET pilot plant, in the spot where stainless steel and copper alloy were used, whereas no corrosion was observed in the spot where SUS material was used. (1 tab)

18094 (NP—8770046, pp 909-912) **Verification survey on environmental maintenance concerning large scale deep geothermal power plant.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is an annual report for 1985 on the verification survey concerning the environmental safety of the cycle of collection, utilization, and reinjection of deep geo-thermal fluid. (1) Underground survey: In the Jizobara district, test wells of 3000 m depth were drilled. As the gas-evolving test was successful with duration of several months, a well test was carried out accordingly. A comprehensive analysis based on the collected data led to a preparation of a deep geothermal structure model. (2) Planning and design of a total system: By analyzing the data of well pressure of the two wells, a geo-reservoir model was improved and a simulation on the natural condition of the Jizobara district was carried out. (3) Environment monitoring: Such five monitoring items as an observation of the change in the underground water, etc. and such seven items as meteorological observation, etc. were obtained.

1507 By-products

REFER ALSO TO CITATION(S) 18548

1508 Geothermal Power Plants

18095 (NP—8770044, pp 285-312) **Development of binary cycle power generation plant. Design of 10 MW-class plant.** Masuno, Noboru. (Electric Power Development Co., Tokyo, Japan). 21 Sep 1984. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

In Proceedings of parallel sessions for the 4th NEDO general assembly.

This research has been in execution as a part of the Sunshine Project and the research work of elements concerned have been in progress since 1979. 1) Operation mediums; Since hydrocarbon mediums as isobutane etc. are hazardous for long term operations of a plant of large capacity due to their inflamability, design works were newly started for a plant using R-114 as operation medium. 2) Temperature of hot water: The temperatures of hot water for design are 130'C and 140'C, however since the amount of hot water flow necessary for a 10 MW plant exceeds 1,400 t/h, not many promising sites could be expected. Consequently, development of downhole pump is now under study for a much wider temperature range. 3) Temperature of draining hot water: Concerning the temperature of draining hot water at the exit of the plant, the durability of reinjection wells might be shortened by descaling depending upon the quality of the water. Accordingly lower temperature hot water reinjection is now under study. 4) Others: With regard to the mist-cooling air-cooled condensing method, corrosion of alminum fin tubes might occur depending upon the quality of the water. Accordingly a water-cooled condensing method is now in the design stage. (17 figs)

18096 (NP—8770045, pp 293-307) **Development of binary cycle power generation plant. Development of 10 MW class plant.** Sato, Mitsuo. (New Energy Development Organization, Tokyo, Japan). 20 Sep 1985. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

In Proceedings of parallel sessions for the 5th NEDO general assembly.

This is a report of 1985 for NEDO contracted project. Aiming at developing a 10 MW class demonstration plant, Rand D was carried out by the operation study of the pilot plant and the study of the elemental technology. Optimum conditions for preventing the capacity reduction of the reinjection wells and the production wells were established on the basis of the following findings. An axial flow type medium turbine with a mechanical seal was found appropriate. A ball washing was effective for removing the scale in the hot-water side heat-conducting pipe of the preheater and the evaporator. An optimum heating medium was R114 at 150 - 200 'C of the geothermal water. An optimal design by combining a main flow-down water film type condenser and a fluted type auxiliary condenser greatly improved the heat transfer coefficient. A study on a downhole pump led to the stage of a plant scale test to confirm the performance and the reliability of the prototype unit (50 t/h X 300 m X 100 KW, max. water temperature 170 'C). (6 figs, 4 tabs)

18097 (NP—8770045, pp 308-334) **Development of downhole pump.** Kudo, Ryoichiro. (Ebara Corpration, Tokyo, Japan). 20 Sep 1985. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

In Proceedings of parallel sessions for the 5th NEDO general assembly.

This is a report of 1985 for NEDO contracted project. A submerged motor driving system in the well, which was best suited for the Japanese geothermal resources and the technology of utilization, was selected, and development items for the verification unit with 100 t/h capacity. In the system, two 100 KH motor sections are connected in series to obtain 200 KW capacity. Considering a future up-scaling and a limitation in the well diameter, 1,500 V was concluded as the most suitable voltage, and an elementary technology for the hot water temperature of 140 'C. For example, a psecial 2-phase stainless steel was selected for a casing and an impeller, and Ni-alloy for a main shaft of the pump. Addition of an additive is also considered to satisfy the requirement of the sealed-in oil. An insulation system with organic material was concluded best for the stator coil insulation from the viewpoints of the product properties and the winding workability. A full consideration was made on the severe work environment with regard to the power cable installation to connect the distance of 400 - 500 m up to the downhole motor. (9 figs, 9 tabs)

18098 (NP—8770046, pp 720-728) **Development of geothermal hot water power generation plant. Development of a binary cycle power generation plant, development of a 10 MW class demonstration plant (study of element technologies).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

Research and development was conducted for a high-efficiency heat exchanger to be used in a binary cycle power generation plant which effectively utilizes energy geothermal hot water has. The heat exchanger using a heat medium mixture and techniques for stabilizing the heat medium were investigated. This paper summarizes the study conducted in each year from 1983 to 1984, and outlines the results of the studies. For study on the heat exchanger, tests were conducted with a heat exchanger in which a smoothing pipe was used as the thermal transmission pipe. for each of the condenser and evaporator making up the heat exchnger, data about the relationship among the heat transfer coefficient, thermal flux, and each heat medium, the pressure loss, and the temperature distribution in the direction of medium flow was obtained. In the heat medium stabilization study, heat stabilizing agents were tested for the purpose of improving the thermal stability of heat medium R114. The heat media which showed a marked effect are triphenyl borate, dimethyl phosphite, and methyl acrylate. (2 tabs)

18099 (NP—8770046, pp 729-735) **Development of geothermal hot water power generation plant. Development of binary cycle power generation plant; development of a 10 MW class demonstration plant (development of a 10 MW class plant).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

A test well was excavated in a typical area of geothermal resources producing middle- to high-temperature hot water. Using this test well, preliminary investigation, including well tests, geo-

thermal reservoir evaluation, and plant system examination, was conducted. This paper summarizes the study conducted in each year from 1981 to 1984, and outlines the results of the studies. The test well was 900 m deep; the maximum temperature measured was 188.7°C. Using the test well and two existing wells, well tests were conducted to evaluate the temperature, pressure, productivity index, and other parameters of the geothermal reservoir. The streaming potential method was applied to the test well to help determine the position of the next test well. The obtained basic data was utilized to select a binary cycle power generation plant using a 10 MW class downhole pump, develop a program for finding optimal running conditions in response to variations in the flow rate and temperature of the geothermal hot water and the wet-bulb temperature of the atmosphere, and perform simulation. In addition, each of the candidate positions for excavation was evaluated. (1 tab)

18100 (NP—8770046, pp 736-745) **Development of geothermal hot water power generation plant; Development of binary cycle power generation plant, development of a 10 MW class demonstration plant (development of a downhole pump).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

A downhole pump driven by a motor located in water was developed in order to effectively utilize geothermal hot water which remains as an unused resource because of weak self-blowing force or other factors. The investigation condcted is divided into the following: study on elemental technologies, design and fabrication of a verification unit, and evaluation of well capabilities. The elemental technologies studied concern the bearing, shaft seal, pressure equalizer, motor sealing oil, stator coil, cable, and basic materials. The requirements for these components and materials were that they must endure geothermal hot water at 200°C. For the verification unit (with delivery of 100 t/h), the impellers and guide vanes were hydro-designed according to the planned performance curve. Test pump No. 1 (flow rate: 57.8 m^3, head: 300 m, motor power: 100 KW) was factory-tested, and proved through a continuous run for 500 hours at a geothermal hot water temperature of 140°C to be good in performance and functions. The motor for this pump was designed and elaborated. Its vibration was analyzed at its natural frequency and under no-load condition, and proved to raise no problem.

18101 (NP—8770046, pp 746-761) **Development of geothermal hot water power generation plant. Development of binary cycle power generation plant, study on productive injection of geothermal hot water (research and development concerning low temperature geothermal water).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

Water circulating tests using test equipment simulating an injective layer and injection tests using an actually excavated injection well were conducted to clarify the injection well attenuation mechanism which acts when low-temperature geothermal water after the utilization for binary cycle power generation or other purposes is reinjected underground. This paper summarizes the study conducted in each year from 1981 to 1985, and outlines the results of the studies. The injection simulation tests were performed as water circulating tests and basic tests. The water circulating tests aimed to get an understanding of the injection temperature limit, scale stuck to the heat exchanger, design requirements for binary cycle power generation, and parameters for creating a model of the injection well attenuation mechanism. The basic tests were conducted to examine scale reduction by the use of pre-sticking of scale and pH adjustment by the use of exhaust gas from the power generation plant. In the injection verification tests, actual injection was performed using two injection wells for 6 to 12 months in order to evaluate the injection capacity, injectivity index, and transmissibility.(2 figs)

18102 (NP—8770046, pp 762-772) **Development of geothermal hot water power generation plant. Development of binary cycle power generation plant; study on productive injection of geothermal hot water (productive injection mechanism).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

The behavior of injected geothermal water underground and the fluid behavior in geothermal reservoirs were studied in order to effectively utilize geothermal hot water for hydrothermal power generation using a binary cycle power generator, etc. This paper summarizes the study conducted in each year from 1975 to 1984, and outlines the results of the studies. The studies are classified into four categories: investigation into the present state, survey using observation wells, well tracking examination, and simulation-based survey. In the present state investigation, well and geothermal reservoir tests were performed on five wells, and revealed that the jetting fluid flows into the well in two-phase state. The observation-well survey clarified accurate changes with time of the pressure in the geothermal reservoir. The well tracking examination clarified the characteristics of the geothermal reservoir state with the aid of temperature and pressure distributions in each well. The simulation-based survey clarified the fluid behavior in the geothermal reservoir. (1 fig)

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 18083, 18099, 18101

18103 **Numerical simulation of fluid-particle flows: Geothermal drilling applications.** Givler, R.C.; Mikatarian, R.R. (Fluid Mechanics and Heat Transfer Div. 1511, Sandia National Labs., Albuquerque, NM). *Journal of Fluids Engineering;* **109**: No. 3, 324-331(Sep 1987).

In order to understand how a particulate plug may evolve within the flow of an essentially homogeneous suspension, they developed a fluid-particle flow model. This theoretical model is based upon a monodisperse collection of rigid, spherical particles suspended in an incompressible, Newtonian liquid. Balance equations of mass and momentum are given for each phase within the context of a continuum mixture theory. The interactions between the phases are dominated by interfacial drag forces and unequilibrated pressure forces. The pressure associated with the solid particles is given by a phenomenological model based upon the flow dynamics. Of primary concern is the calculation of solid particle concentrations within a flow field to indicate the initiation of a particulate plug.

18104 (NP—8770046, pp 779-787) **Development of geothermal hot water power generation plant. Development of binary cycle power generation plant; study on productive injection of geotherma hot water (prevention of calcium carbonate scale adhesion).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is an annual report for 1985 on the study which was started in 1984. 1) A counter-measure for the abrasion of the caliper arm tip was established. A program to calculate the amount of scale adhesion from the caliper measurement was developed. 2) Formation of calcium carbonate scale is affected by the ratio Ca^{2+} : HCO_3^- : CO_2. It is also affected by the temperture, flow rate of the hot water, and the well temperature. 3) Among the agents to restrict the scale adhesion, polyacrylic-acid-based compound, A-30, gave the least adhesion. This was also proven by the actual well test in which such physical characteristics as the ejecting flow rate and the well exit pressure, and such chemical characteristics as the concentration of Ca and Hg, and the variation of Hg/Ca ratio were measured.

18105 (NP—8770044, pp 313-344) **Development of deep-seated geothermal hot water supply systems.** Yoshimura, Yuzaburo. (Japan Petroleum Exploration Co. Ltd., Tokyo, Japan). 21 Sep 1984. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

In Proceedings of parallel sessions for the 4th NEDO general assembly.

Hot water extraction and reinjection tests were performed with the Yuwa NEDO wells (4 wells) near New Akita Airport in Akita Prefecture. The results mentioned below were obtained from its continous operations for 46 days. 1) Ground change survey; Having compared the data from the leveling surveys of six times, changes of relative height were extremely small. It can be judged that no ground changes exist which were caused by this experiment. 2) Preparation of deep-seated geothermal hot water reservoir model; Based upon the results of the researches up to 1982, a three-dimensional model was prepared. Concerning temperature changes with the lapse of time, both measured values and calcurated values indicated the downward trend slightly. Sandstone layers at the experiment site are subdivided downward as Upper, G, Lower G, H, I_1,I_2, and J. It was also confirmed that the layers contributing to hot water extraction are Lower G and I_2 layers and those contributing greatly to reinjection are G, Lower G, and I_1 layers. In addition, the permeability rate around the reinjection wells showed the trend of reduction before the interruption of the tests and the trend of increase after it. (25 figs, 6 tabs)

18106 (NP—8770046, pp 773-778) **Development of geothermal hot water power genevation plant. Development of binary cycle power generation plant; study on productive injection of geothermal hot water (development of the most suitable hot water production method).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is the annual report on the work achieved during 1985 concerning the continued research on the effective utilization of hot water in the process of geothermal electricity generation since its inception in 1982. The two dimentional and three dimentional double porosity grid models were developed for each of the three types of thermal reservoirs, i.e. high-temperature hot water type, steam-dominated type and mixed type, and the case simulation was made for these models in order to calculate changes with lapse of time of temperature and pressure distribution. The model of flow in a production well was made for the simulation of the characteristics of steam-blow from the well. The economic model was also developed for the evaluation of prospecting methods and its economic feasibility. As the result, evaluation on the following subjects became feasible: (1) The number of needed production wells taking into account reservoir behavior, (2) The working life of the well system and the potential amount of hot water for production taking into account pressure changes of reservoirs and decrease of fluid temperature due to reinjection, (3) Merits and demerits concerning the single flash system and the double flash system taking into account reservoir behavior associated with production.

18107 (NP—8770046, pp 797-810) **Development of hot dry rock power generation system.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 Annual Report.

A practical test for the commercialization of hot dry rock power generation was carried out as a part of the second Period Fenton Hill (U.S.A.) Program based on the IEA agreement. This research is substantially a continuation of the work started by the Agency of Industrial Science and Technology at Hijiori district (Yamagata Prefecture) in 1984. Shooting was made for a well with 1800 m depth, and observation was made by a diophone sonde which was placed at 800 m depth in a well which was horizontally 650 m apart. 1) In the study of constructing an artificial reservoir, amount of water naturally flowing down was 10 - 1.2 t/H in the water-pouring experiment in 1984. A gamma-ray inspection indicated water-permeable spots in the granite layer. 2) A casing of 7 inches diameter with compression above 450 kg/cm^2 was installed down to 1790 m depth, and the gap between the well wall was cemented. Water pouring test in Oct., 1985 showed the decrease of the naturally flowing water down to 1/40 only. Average rate of water permeability was estimated as low as 1.8 - 2.5 x 10^{-7} m^3. (16 figs, 2 tabs)

18108 (NP—8770039, pp 319-337) **Research and development of power generation utilizing hot dry rock.** Kuriyakawa, Michio. (National Research Inst. for Pollution and Resources, Tokyo, Japan). 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

This is a report of the writer as a researcher of NEDO who has participated for 8 months from September 1985 in the joint IEA research, performed for 7 years in New Mexico, U.S.A. on geothermal energy of the hot dry rock. During this period, several geothermal wells were drilled, and hydraulic fracturing was performed on the bottoms and direct under the casing shoe to form a storage layer. The power generation system was further developed by branch-drilling from other wells, by guide-drilling from one to another well, and so forth. In May and June 1986, when circulation test was conducted, hydraulic fracturing was successful in evaluating a storage layer produced on a base rock at a depth of 3600 m and at a temperature of 240'C. (17 figs, 2 tabs)

18109 (NP—8770045, pp 335-352) **Research and development of power generation system using hot dry rock.** Matsunaga, Isao. (National Research Inst. for Pollution and Resources, Tokoy, Japan). 20 Sep 1985. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

In Proceedings of parallel sessions for the 5th NEDO general assembly.

The development of geothermal energy by the hot dry rocks was proposed by the Los Alamos National Laboratory in U. S. and a program was arranged to extract the thermal energy of 20 - 50 MW dealing with the rocks 4.5 km under the ground and with the temperature of 320'C as objectives, and participations were requested to Japan and West Germany. The main body in Japan to carry out the program was decided to be NEDO and reserchers were being sent to Los Alamos and the collection of the technical information is continued. The present report describes the progress of the hydraulic spallation test in the HDR Program, the results of the reexcavation from EE - 3 (production well) and the penetration of EE - 2 (penetration well) and the prospect of the circulating heat extraction test to be performed hereafter. Namely, in Exp. 2025(EE - 3) of 1982, the flucstring was broken, and it was clarified that this was due to the stress corrosion damage by H_2S. (17 figs, 1 tab)

18110 (NP—8770046, pp 811-821) **Development of deep-seated geothermal hot water supply system. Development of production and injection system.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

Research was made for establishing an optimum production and reinjection technology concerning a deep geothermal hot water supply system by means of non-volcanic geothermal energy. 1) Extraction and utilization of the deep geothermal hot water energy by means of a closed system was proven to be possible. The primary production level is 60 t/H at 68 'C and an accompanying natural gas is simultaneously available at 2,600 m^3 per day. 2) A tracer test on the hot water circulation made it possible to analyze the behavior of the hot water in the reservoir. 3) A study on the hot water temperature through production and injection cycle showed that the reduction in the temperature was not observed if the distance between the wells is kept wider than 300 m for 20 t/H rate and above 600 m for 60 t/H rate. (5 figs, 4 tabs)

16 Tidal And Wave Power

REFER ALSO TO CITATION(S) 17915

1604 Economics

REFER ALSO TO CITATION(S) 18046

1608 Wave Energy Converters

REFER ALSO TO CITATION(S) 18046

17 WIND ENERGY

REFER ALSO TO CITATION(S) 17915

18111 **(EUR—11117) Wind energy: European research and development: Contractors' catalogue.** Palz, W.; Caratti, G. (eds.). (Commission of the European Communities, Brussels (Belgium)). 1987. 79p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88900398/JAW.

This catalogue contains two-page summaries of the results obtained in the contracts on wind energy R and D which were concluded between the Commission of the European Communities, Directorate-General XII "Science, Research and Development," Brussels, Belgium, and a number of public and private research institutions in the European Community.

1701 Availability (climatology)

REFER ALSO TO CITATION(S) 17920

1704 Economics

REFER ALSO TO CITATION(S) 18114

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 18024, 18155

18112 (NP—8770039, pp 200-216) **Research and development of 100 KW class wind power gereration system.** Hirayama, Takashi. (The Tokyo Electric Power Co., Inc., Tokyo, Japan). 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

This study was conducted under commission from NEDO. At the end of 1982, a verification plant for 100 KW class wind power generation systems was construced, and was run to study the strength, reliability, controllability, power generation characteristics, and influence on the power distribution system of the equipment. The constructed system is outlined as follows: The rated power is 100 KW; the rated wind velocity is 10 m/s; the rotor diameter is 29.4 m; the rated speed of rotor rotation is 51 rpm, the power generation method is a DC link separately excited inverter method; operation control schemes are yaw control for wind direction, variable-pitch control for wind velocity, constant-rpm control for rotor rotation, etc. The achievements are as follows: The test duration is 1488 h; the running time is 629 h (against 968.7 h which is the theoretical value obtained from wind condition data); the generated electric energy is 41,707 KWh (against 71,554 KWh which is the theoretical value); the equipment utilization rate is 28.0% (against 48.1% which is the theoretical value). The influence on the power distribution system was low as indicated by the voltage regulation of 0.5% or less, the frequency variation of 50 +- 0.1 Hz, and the harmonic content of 1.6 to 3.8%. This suggests that the influence is insignificant. The cut-in and cut-out wind velocities were changed from the design values 5.0 m/s and 14 m/s to 5.0 m/s and 22 m/s, respectively. This widening of the wind velocity range for system activation has raised no problem. (10 figs, 8 tabs)

18113 (NP—8770046, pp 670-680) **Development of large scale wind turbine power generation system. Development of pilot plant of 100 KW class.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is a report of studies in 1985 on linkage operation tests connecting a destribution line system and a 100 KW experimental wind power generator installed on Miyakejima Island with the objective to develop a large scale wind power generation system for the practcal use as a part of the policy of expediting the diversification of electric sources. The results obtained are as follows: (1) Control response of wind power turbine; As for variable pitch control and yaw control in association with variation of wind speed and direction, the frequency of stoppage due to over speeding of the wind was reduced to almost nil and other proper control became feasible. (2) Strength of wind turbine; By raising the set value of cut out against high wind speed up to 22 m/s, the wind turbine was confirmed to be usable against high wind speed. (3) Characteristics of power generating output; As for the characteristics of wind speed and power generation output, the experimental value was 205 higher than the theoretical value. The data concerning the relationship between operating time and the quantity of generated power were also obtained. (4) Effects to distribution system; As for the effects on voltage variation, no problem was confirmed. As for the effects on frequency variation, troubles were resolved by modifying the control system. (5) Reliability of equipments; The necessity was confirmed for taking into due consideration the climatic changes and damages from sea wind in designing equipment and maintenance data were obtained. (5 figs, 3 tabs)

18114 (NP—8770046, pp 681-688) **Analytical study of large scale wind power generation system.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

Study to evaluate a wind power generation system has been carried out, which is based on design, producing and operating data of a 100kw class experimental machine and the wind condition, etc. In addition, analysis for the commercialization of the wind power generation and examination of a wind force utilization system are being proceeded, too. The result in 1985 is as following. (1) A distribution map of wind conditions in Japan was prepared, while comparing with that of U.S.A. (2) It was concluded that the potentiality of the plants to be installed was 6600units(1270MW) for the Honshu, the main island and 436units(37MW) for the remote islands. (3) Effects of noise on human beings can be ignored, but radionoise cannot be ignored and it is necessary to make up some counterplan.

18115 (NP—8770046, pp 689-695) **Development of MW class large scale wind power generation system. Observation of wind character.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

A study was made in the period of December 1985 to February 1986 aiming at wind character analysis, necessary for the design of a wind power generation system for the cape area. Observation was made in the vicinity of the top of Mt. Kuwahata-yama at Shiriya machi, Aomori Prefecture, Japan, where XONDAR was used as an equipment. The results of observation were as follows. (1) Main direction in the winter is WNW and average wind velocity for individual month was 11.3 - 14.7 m/s. (2) Daily variation of the wind velocity for the entire period was 13.4 +- 5.8 m/s. (3) A peak of wind velocity frequency distribution was in the range 8 - 15 m/s. (4) The appearance rate of the wind velocity for cut-in and cut-out regions was approximately 90% indicating the potential of acquiring considerable amount of energy. (3 figs, 2 tabs)

18116 (NP—8770046, pp 696-706) **Development of MW class large wind power generation plant. Conceptual design-soft system.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is a NEDO annual report for 1985. By selecting a peninsula area (in Aomori Prefecture) and a sea-shore area (in Hok-

kaido), system design, specification, control method, and system connection method were determined, and methods of the material transportation and the assembly were examined. Cost of installation and power generation was calculated. The capacity found suitable for the peninsula area is 48 m diameter and 800 kW output, and 70 m and 600 kW for the seashore area. A structure of room-temperature-curing polyester resin with glass fibers was found suited for a large blade. A variable speed system was adopted for operation control. An AC-DC-AC linkage system was adopted by utilizing an 8-pole vertical separately-excited synchronous generator. The total weight of the materials is less than 20 tons by using an angle drive system and transported by a low-floor type trailer. The materials can be assembled by hanging with a crane. (5 figs, 2 tabs)

18117 (NP—8770046, pp 707-713) **Development of MW class large wind power generation plant. Conceptual design-semisoft system.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is a NEDO annual report for 1985. Plant site is Rumoe for a sea-shore area and Shiriya-saki for a peninsula area, both need consideration in winter for such natural conditions as cold climate, snow, salt damage, dense fog, and thunder. For each site, specifications were set for 600, 800, and 1,000 KW capacity respectively by examining a rotor diameter and a tower height on the basis of the wind data and the peripheral ratio (7.5 - 10.4) which would give the maximum power generation. A capacity of 1.000 KW was regarded advantageous according to the cost calculation. For the manufacture of a long blade above 50 m diameter, a solid wing was adopted because of less technical risk. Concerning the operation control, freezing, shrinkage and work deficiency of the parts in winter and ventilation and cooling in summer must be examined. As for the power quality, four types of security function were defined in relation with alarming and stoppage. Both marine and car transportation means are to be employed, but a certain investigation is needed because of narrow roads (4 m width). (1 tab)

18118 **(PNL-SA—15370) Simulating high-resolution vertical plane array wind characteristics using lower-spatial-resolution wind measurements.** Powell, D.C.; Connell, J.R. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 7p. (CONF-880132—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005626/JAW.

From 7. wind energy symposium; New Orleans, LA, USA (10 Jan 1988).

Several sets of 12-anemometer rotational wind data from the Clayton, New Mexico, vertical plane array were reduced to 6-anemometer rotational data by including every other anemometer. Statistics of these reduced data were compared to statistics of the original 12-anemometer rotational data. Also, techniques based on assumptions were employed to simulate the original 12-anemometer data by using the reduced data as part of constructed 12-point data series. Good statistical comparisons were conditionally, but not consistently, obtained.

20 ELECTRIC POWER ENGINEERING

18119 (NP—8770046, pp 437-444) **Research and development on peripheral technology. R and D on power converter for solar cell generation (for independent power source).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

In order to attain, for an AC/DC transformation unit for an independent 10 KW class power source, high efficiency, high reliability, low cost, and compactness, etc., the following development was carried out. (1) Basic study on the major functions of an inverter clarified the advantage of BIMOS transistor for a switch element and of HFPWM inverter system for an inverter. (2) A base drive circuit of a power switching element was trially made followed by a test on various characteristics. By this test, it was found that BIMOS transistor low on voltage only and showed low swiching time, thus enabling a HFPWM action by high frequency wave. A functional model was designed for examining the fundamental problems in the main circuit of an inverter. (3) A primary trial product of an inverter with 12.5 KVA capacity was made with an aim to establish a design technique for an independent power inverter. (3 figs, 5 tabs)

18120 (NP—8770046, pp 445-450) **Reaearch and development of peripheral technology. R and D on electric converter unit for solar cell generation, (for system connector).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

Development of a compact, highly reliable, highly efficient, low cost, and maintenance-free electric power conversion unit was made. (1) Comparative study on a main circuit indicated the disadvantage of a direct current insulation system from the viewpoint of efficiency and cost in comparison with an A.C. insulation and a transformerless systems. As to the control circuit, instantaneous current control PWM system which could reduce the harmonic element was adopted. (2) On the basis of above result, a basic specification of 3 KW class power converter was set and a primary trial unit was designed and manufactured. Concerning a main circuit of an inverter, an interchangeable structure of 3 types of MOS switching element was adopted, thus enabling to check the existence of an insulating transformer. (5 figs, 2 tabs)

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 17407, 17413, 17413, 17482, 17492, 17501, 17535, 17536, 17537, 17538, 17539, 17540, 17541, 17543, 17545, 17551, 17561, 17622, 17623, 17634, 17635, 17645, 17660, 17662, 17662, 17665, 17892, 18333, 18334, 18335, 18409, 18411, 18412, 18413, 18414

18121 **(EPRI-CS—5487-Vol.1) PFBC [pressurized fluidized bed combustion] turbocharged boiler design and economic study: Volume 1, Executive summary: Final report.** (BBC Brown Boveri, Inc., North Brunswick, NJ (USA); Combustion Engineering, Inc., Windsor, CT (USA); Decision Focus, Inc., Los Altos, CA (USA); Fluor Engineers, Inc., Chicago, IL (USA); Foster Wheeler Development Corp., Livingston, NJ (USA); Hoy Associates, Fetcham (UK)). Nov 1987. 123p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920100/JAW.

A coal combustion technology that promises to reduce the cost of electrical power is pressurized fluidized bed combustion (PFBC). Since a PFBC boiler is physically smaller than a conventional pulverized coal fired boiler with a flue gas desulfurization system (PC/FGD) and the same power rating shop assembly and modularized shipment to the power plant site can be considered. Modular construction can substantially reduce the overall design/construction time. Emission controls are equivalent to, or better than, conventional PC/FGD units, and the PFBC combustor can tolerate coals with a wider range of characteristics. Two PFBC plants and the reference PC/FGD plant were each to have four nominal 250 MW(e) units to be completed for start-up at one year intervals. To establish a well defined consistent design basis for all units, the turbine-generator and steam cycle of a recently constructed 250 MW(e) unit (designed by Fluor and built under Fluor construction management) was selected and made the common element in both of the PFBC plants and the reference PC/FGD plant. Steam conditions of 2400 psia, 1000°F were to be identical for all units as were the steam flows for the design load range of 50% to steam turbine valves-wide-open with inlet steam pressure 5% over design pressure (VWO 5% OP). The study produced three plant designs - a 4-unit turbocharged PFBC using bubbling bed technology, a 4-unit turbocharged PFBC using circulating bed technology, and a 4-unit PC/FGD reference plant using conventional pulverized coal technology coupled with wet limestone scrubber technology. The hot gas clean-up system, operating at these more modest temperatures, is capable of reducing the particulate in the gas to a level which meets EPA/NSPS standards without further cleanup. With this level of cleanup, service conditions for the turbocharger turbine are tolerable in commercially available designs and materials. 48 figs., 14 tabs.

18122 **Advanced coal gasification combined-cycle generation using the KRW gasifier - recent pilot plant results and commercialization efforts.** Rath, L.K.; Smith, K.J. (The M.W. Kellogg Co., Houston, TX 77046-0395). pp 1328-1336 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—).

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879066.

This paper describes the evolution of an advanced technology coal gasification combined cycle power plant that has significant advantages over other power generation technologies. The plant will provide lower capital and operation costs and superior environmental acceptability than other modes of generation. These types of plants are targeted to achieve a 30 percent lower electricity cost than conventional coal plants with flue gas desulfurization. Engineering studies conducted by The M.W. Kellogg Company have confirmed this capability to lower the cost of electricity. The design is based on the KRW Energy Systems Inc. pressurized fluidized-bed coal gasification system. A design data base has been developed as a result of extensive pilot plant operation conducted by KRW at the Waltz Mill, PA, site. High-temperature cleaning of the fuel gas is accomplished using concepts being developed at the Waltz Mill pilot plant. Primary desulfurization of the fuel gas is by injection of a calcium-based sorbent into the gasifier bed. Final gas cleanup is accomplished by a hot gas cleanup system consisting of: an external filter or high-efficiency cyclone, a polishing desulfurizer with zinc-ferrite sorbent, and a final protective cyclone or filter prior to the turbine. Net power output from the prototype plant is nominally 64 MW and the overall plant heat rate is 9000 Btu/kWh (HHV). A larger 385 MW unit, based on current turbine technology, will have an overall heat rat of 8150 Btu/kWh, and the cost of electricity on a levelized basis will be 46 mills/kWh (1990).

18123 **(EPRI-CS—5495) Microbial corrosion in fossil-fired power plants: A study of microbiologically influenced corrosion and a practical guide for its treatment and prevention: Final report.** Pope, D.H. (Rensselaer Polytechnic Inst., Troy, NY (USA). Dept. of Biology). Nov 1987. 87p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920108/JAW.

The results of a survey of fossil fueled electric generating stations done to determine the occurrence of microbiologically influenced corrosion (MIC) in various systems is presented. This shows that MIC occurs in most, if not all, systems present in these plants. A large variety of alloys are used in these systems; most appear to be MIC susceptible. None of the operational modes and types of water treatment reported seem to prevent MIC in all systems in which they are used. The results of several site visits by the principal investigator are also presented. These visits allowed direct documentation of MIC in all of the plants visited. This included demonstrating the presence of MIC causing microorganisms and corrosion with the metallurgical picture which has recently been established as unique to MIC of carbon steel piping. Background information on MIC, including newly discovered metallurgical features and the mechanisms of attack by acid producig bacteria, is presented. Methods for the detection, prevention and treatment of MIC are presented. A guide to the investigation of MIC in fossil plants including a step-by-step procedure for obtaining samples and performing microbiological, chemical and metallurgical analyses is provided 14 refs., 15 figs., 6 tabs.

18124 **Experimental results of cooling cycles with clathrate energy storage.** Schaetzle, W.J.; Gadalla, M.A.; Najafi, M. (The Univ. of Alabama, Tuscaloosa, AL). pp 1317-1323 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—).

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879375.

Closed loop cooling cycle using clathrate as a storage medium have been operated to verify the system operation and to evaluate the system operation and to evaluate the system components. The system operated with direct contact heat transfer between the refrigerant and the water and clathrate. A test facility has been constructed to operate these cycles. The system has visual access to the storage operation volume and the heat transfer area. In addition, the constructed system has the capability to be reversed between cooling and heating utilizing the same thermal energy storage (TES) system. The system can be utilized to evaluate other chemical storage with direct contact heat transfer process as well as the basic clathrate storage. Runs have been performed using Refrigerant 114, Refrigerant 114 and water, Refrigerant 12, and Refrigerant 12 and water. A computer code has been developed to analyze the data for each run. Emphasis is placed on the storage system with additional calculations for energy charging, energy storage, and energy recovery from storage. Energy balances for the entire system indicate energy errors are limited to a few percent. The experimental results show the system operates effectively with direct contact heat transfer between clathrates or water and Refrigerant, and reveal potential for cooling and heating with a common thermal energy storage system. The addition of salts to some clathrates have produced new phase diagrams advantageous to the thermal storage system.

18125 **(DOE/MC/23088—2532) Assessment of instrumentation needs for advanced coal power plant applications: Final report.** Nelson, E.T.; Fischer, W.H.; Lipka, J.V.; Rutkowski, M.D.; Zaharchuk, R. (Gilbert/Commonwealth Associates, Reading, PA (USA)). Oct 1987. Contract AC21-86MC23088. 200p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88001030/JAW.

The purpose of this study was to identify contaminants, identify instrumentation needs, assess available instrumentation and identify instruments that should be developed for controlling and monitoring gas streams encountered in the following power plants: Integrated Gasification Combined Cycle, Pressurized Fluidized Bed Combustion, and Gasification Molten Carbonate Fuel Cell. Emphasis was placed on hot gas cleanup system gas stream analysis, and included process control, research and environmental monitoring needs. Commercial process analyzers, typical of those currently used for process control purposes, were reviewed for the purpose of indicating commercial status. No instrument selection guidelines were found which were capable of replacing user interaction with the process analyzer vendors. This study leads to the following conclusions: available process analyzers for coal-derived gas cleanup applications satisfy current power system process control and regulatory requirements, but they are troublesome to maintain; commercial gas conditioning systems and in situ analyzers continue to be unavailable for hot gas cleanup applications; many research-oriented gas stream characterization and toxicity assessment needs can not be met by commercially available process analyzers; and greater emphasis should be placed on instrumentation and control system planning for future power plant applications. Analyzers for specific compounds are not recommended other than those needed for current process control purposes. Instead, some generally useful on-line laser-based and inductively coupled plasma methods are recommended for further development because of their potential for use in present hot gas cleanup research and future optimization, component protection and regulation compliance activities. 48 refs., 21 figs., 26 tabs.

18126 (DOE/METC—87/6079-Vol.1, pp 123-136) **Assessment of instrumentation needs for advanced coal conversion power plants.** Nelson, E.T. (Gilbert/Commonwealth, Inc., Reading, PA). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1). Contract AC21-86MC23088.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

Integrated Gasification Combined Cycle (IGCC), Pressurized Fluidized Bed Combustion (PFBC), and Molten Carbonate Fuel Cell (MCFC) power systems are considered. The study involves identifying contaminants and their control levels in power system gas streams, assessing available and instrumentation for measuring and monitoring these contaminants, and identifying deficiencies in the types of instruments available. It was beyond the scope of this study to generate optimized conceptual designs for the IGCC and MCFC power plants based on the hot-gas cleanup option. However, having established a set of base case instrumentation requires for the cold-gas cleanup options, their instrumentation

needs assessment work was then directed toward the following three hot gas cleanup options: (1) The METC Zinc Ferrite Process - based upon the use of zinc ferrite, $ZnFe_2O_4$, which tends to combine the high sulfur affinity of zinc oxide with the good regenerability of iron oxide. The zinc ferrite is regenerated by roasting with air or oxygen. (2) The Battelle Solid-Supported Molten Salt (SSMS) Process - based on the reversible reaction of H_2S with molten lithium, sodium, potassium or calcium carbonates. Regeneration with a carbon dioxide and steam-rich stream releases H_2S at a high concentration which is converted to elemental sulfur. (3) The IGT Mixed Metal Oxide Process - based on the use of an elemental sulfur producing metal oxide sorbent combined with a high sulfur affinity metal oxide. After the metal oxide is fully loaded, it is regenerated using a mixture of oxygen and tail gas. Results to date are discussed. 6 references, 4 tables.

18127 (DOE/METC—87/6079-Vol.2, pp 704-715) **High-temperature solid oxide electrolyte fuel cell power generation system.** Lippert, T.E.; Lundberg, W.L.; Parker, W.J. (Westinghouse Electric Corp., Pittsburgh, PA). Aug 1987. NTIS, PC A19/MF A01. Order Number DE87006496/JAW. (CONF-870659—Vol.2).

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The purpose of this task is to establish developmental goals for the Solid Oxide Fuel Cell (SOFC) technology based upon the requirements of commercial power generation systems. Systems analysis and conceptual design studies are being conducted to define candidate Integrated Gasification, Solid Oxide Fuel Cell (IG/SOFC) power cycle arrangement, plant and component design requirements and economic goals for central station utility applications. Nine potential applications for IG/SOFC plants were defined and reviewed by selected utilities. Based on this review, the utilities believed that a 250 MW(e) coal based central station SOFC power plant is one preferred application for this technology. Other preferred applications include repowering of existing coal, oil and gas units in the 150 to 300 MW(e) power range and application of small modular 5 to 50 MW(e) units operating on natural gas. Conceptual plant design studies are in progress to define potential IG/SOFC systems for a central station application. Two basic power cycles were identified and then system models developed and parametric studies were conducted for an IG/SOFC-Steam Turbine Combined Cycle Plant. Heat and material balances and plant performance were calculated for this cycle for three basic gasifier types. This study showed that any one of the three gasifier types could be integrated with an SOFC Steam Turbine power cycle with resulting plant efficiencies that range from about 43 to 47% coal pile to busbar. A reference design study was conducted for the KRW/SOFC - Combined Cycle plant where component costs were estimated and the relative effect of varying fuel cell operating parameters on relative COE was studied.

18128 **Satisfying winter peak-power demand with phased gasification.** Hall, E.H.; Moss, T.E.; Ravikumar, R. (Dept. of Energy, Portland, OR). *Transactions of the American Nuclear Society;* **54**: 3-4(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

The purpose of this study, commissioned by the Bonneville Power Administration, was to investigate application of this concept to the Pacific Northwest. Coal gasification combined-cycle (GCC) plants are receiving serious attention from eastern utilities. Potomac Electric (PEPCO) has engaged Fluor Technology to perform conceptual and preliminary engineering for a nominal 375-MW coal GCC power generation facility to be located in northern Montgomery County, Maryland. Other eastern utilities are engaged in site-specific investigations of satisfying future power requirements employing this alternative, which involves an environmentally superior method of using coal. Coal is combined with oxygen to produce a medium-heating-value fuel gas as an alternative to natural gas. The fuel gas, cleaned to remove sulfur compounds, is burned in gas turbine-generator sets. The hot exhaust gas is used to generate steam for additional power generation. The gasification combined cycle plant is highly efficient and has a high level of flexibility to meet power demands. This study provided background for consideration of one alternative for satisfying winter peak-load demand. The concept is feasible, depending on the timing of the installation of the gasification system, projections of the cost and the availability of natural gas, and restrictions on the use of natural gas. It has the advantage of deferring capacity addition and capital outlay until power is needed and economics are favorable.

18129 **(PB—88-117932/XAB) Utilizing wood residue for energy generation in northwestern Montana: a feasibility assessment. Forest Service general technical report.** Keegan, C.E.; Jackson, T.P.; Withycombe, R.P.; Barger, R.L.; Chase, A.L. (Forest Service, Ogden, UT (USA). Intermountain Research Station). Oct 1987. 46p. (FSGTR/INT—234). NTIS, PC A03/MF A01.

Wood residue in northwestern Montana is a potential source of fuel for power generation. The most promising sources of residue are fine mill residue and bark, with quantities dependent upon lumber production, and top, limb, and cull material available through whole-tree saw-timber harvesting methods. Utilization of residue for energy is constrained primarily by the cost of recovery of residue material and the relatively low value of the energy produced.

18130 **(DOE/CE/15242—T1) Engineering evaluation of the Hunter rotary gasifier/combustor: Final report.** Levy, E.K.; Sarunac, N. (Lehigh Univ., Bethlehem, PA (USA). Energy Research Center). 1 Oct 1987. Contract FG01-85CE15242. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002805/JAW.

This report is the result of an evaluation of an invention by John Hunter of Edinburgh, Scotland, which was submitted to the Department of Energy for evaluation under Section 14 of the Federal Nonnuclear Energy Research and Development Act of 1974. The invention is based on the use of a rotating fluidized bed for coal conversion. No working models of the invention have been built to date. As part of the evaluation process, Lehigh University's Energy Research Center was asked by DOE to conduct an engineering analysis of the invention and make comparisons with alternative power generation systems. Power generation cycle efficiencies were computed, component sizes were specified, cost data were gathered and relative cost comparisons were made between the Hunter power generation systems and some alternatives. Finally a review of the operational characteristics of the Hunter concepts was carried out. The major unknown quantities were identified and a list of future development needs was specified.

18131 **(EPRI-CS/EL—4415-Vol.4) Power plant performance monitoring and improvement: Volume 4, Boiler optimization: Interim report.** Crim, H.G. Jr.; Levy, E.K. (Potomac Electric Power Co., Upper Marlboro, MD (USA); Lehigh Univ., Bethlehem, PA (USA). Energy Research Center). Dec 1987. 361p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920148/JAW.

The boiler portion of EPRI project RP1681/2153 is concerned with the development of measurement methods and instrumentation and analysis techniques for pulverized coal power plants, for monitoring the performance of a unit and for determining its optimum fireside operating conditions. Three of the physical parameters of interest in this investigation are level of excess air, size distribution of the coal, and stack gas temperature. A computer code has been developed to compute the effects of fireside parameters on power plant performance and field tests are being carried out at the Potomac Electric Power Company's Morgantown Station, where the effects of coal grind size and level of excess air on parameters such as unit heat rate, carbon heat loss, stack loss and boiler efficiency are being measured. A new technique for the direct measurement of unit heat rate, referred to as the output/loss method, is under development and measurements are being made at the regenerative air preheater to determine the effects on acid deposition of operating at reduced levels of O_2. An improved procedure for ultrasonic measurement of waterwall tube thickness has been developed and laboratory experiments were carried out to determine the effects of O_2 level and particle size on the reactions which pyrite undergoes in the furnace. This progress report describes the results of the project for the two year period ending in January, 1986.

18132 **(EPRI-CS/EL—4415-Vol.5) Power plant performance monitoring and improvement: Volume 5, Turbine cycle performance analysis: Interim report.** Crim, H.G. Jr.; Westcott, J.C.; de Mello, R.W.; Brandon, R.E.; Kona, C.; Schmehl, T.G.; Reddington, J.R. (Potomac Electric Power Co., Upper Marlboro, MD (USA)). Dec 1987. 195p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920147/JAW.

This volume describes advanced instrumentation and computer programs for turbine cycle performance analysis. Unit conditions are displayed on-line. Included are techniques for monitoring the performance of feedwater heaters and the main condenser, procedures for planning turbine maintenance based on an analysis of preoutage testing and performance history, and an overview of the project's computerized data handling and display systems. (DWL)

18133 **(EPRI-ER—5619-SR) Center fracture toughness of monoblock rotors: Special report.** Jaffee, R.I. (Electric Power Research Inst., Palo Alto, CA (USA). Energy Management and Utilization Div.; Japan Steel Works Ltd., Tokyo; Kobe Steel Ltd. (Japan); Japan Casting and Forging Corp.). Jan 1988. 41p. Research Reports Center, Box 50490, Palo Alto, CA 93403. Order Number TI88920174/JAW.

Since 1980, about 120 monoblock integral LP rotors have been substituted for half-speed LP rotors with shrunk-on construction or used in new half speed units. Of these, about 50 were installed in US units. The monoblock rotors require very large forgings made from ingots generally weighing over 500 metric tons. The diameters of these monoblocks are about 2.6 meters (9 feet). The cooling rate at the center in heat treating them is slow, and the toughness properties at the center were investigated to ensure that they are adequately high to ensure safe operation. The three Japanese forgemaster organizations furnished EPRI with core toughness, FATT, and tensile data on 17 monoblock rotor forgings in the 2.6 meter diameter class. The properties presented in this report support the conclusions that the monoblock rotors have high fracture toughness at the core and that such rotors are safe to operate from a strength and toughness point of view. 5 refs., 6 figs., 3 tabs.

18134 (NP—8770046, pp 957-978) **Development of advanced type battery energy storage system.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

The target is to develop a power storage system with a so-called load levelling function in which an excess off-peak electricity is stored (charged) by an electrochemical reaction and is released (discharged) at peak-time. (1) Development of a new type R and D. (a) 1 MW class cell which utilizes 300 Ah concerning Na-S cell was studied (on the desk). Conclusions were made on the collective structure, operation control system, and method of maintanance and inspection. (b) For a Zinc - Chlorine cell, a concept of 1 MW class plant using a solvent process was prepared. By this it was made possible to integrate the chlorine storage equipments into one giant unit. (c) Conceptual design and environmental safety of 1 MW class plant were examined for Zinc - Bromine cell. (d) Conceptual design was made for the Redox flow type cell. (e) R and D on the system technology. (f) Study on the total system. (11 figs, 8 tabs)

18135 (NP—8770046, pp 1010-1044) **Research and development of super heat pump energy accumulation systems.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is the 1985 annual report on the reseach and development of super heat pump energy accumulation systems applicable to leveling electric power loads. 1. The objective was found to be promising with the compression heat pump of high efficiency type if a system dedicated for heating with 4 compression stages, 3 condensation stages and a condensate supercooling stage on the lower temperature side is combined with a 2 stage economizer system for heating and cooling. For the high temperature output type, two discharge types, i.e. at the center and both ends, were made on a trial basis low temperature heat source. 2. In the field of chemical heat accumulation technology, application of metathesis reaction which employs olefin for high temperature heat accumulation type was studied. Support catalyst of heterogeneous system was found to be superior. In the use of NH_4 type complex, heat balances of materials used for the component devices were calculated. In the application of hydration reaction, it was learned that the thinner the height of the layer, the faster the heat accumulation and the larger the heat transfer rate. For solvate reation, heat accumulation system was studied. As to the application of solvate reaction for low temperature heat accumulation type in which mixed solvents are used, LiBr was selected. As regards the application of clathrate, the direct cooling system was found to be superior to the indirect cooling system. (14 figs, 12 tabs)

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REFER ALSO TO CITATION(S) 17409, 17410, 17634, 17635, 17661, 17662, 18700, 19288

18136 **(EPRI-EA—5572) Chemical spill exposure assessment methodology: Final report.** Brown, S.M.; Boutwell, S.H. (CH2M Hill, Bellevue, WA (USA)). Jan 1988. 274p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920189/JAW.

This study concentrated on the development of a chemical spill exposure assessment methodology that includes an on-site fate model, off-site transport models, and an exposure analysis program. The on-site model estimates chemical losses from a spill site through volatilization, runoff-soil erosion, and leaching. The methodology converts estimated chemical losses into concentrations offsite using simple atmospheric, surface water, and groundwater offsite models. The exposure analysis program then converts the concentrations into inhalation, ingestion, and dermal contact exposure rates.

18137 (Juel-Conf—59, pp 1-39) **Possibilities of NO/sub x/ reduction.** Weber, E. (Essen Univ., Gesamthochschule, Germany, F.R.). Dec 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751936/JAW. (CONF-8610382—).

From BMFT status seminar: reducing nitrogen oxides from power stations; Juelich, F.R. Germany (1 Oct 1986).

Using the available processes and those being developed, it will be economically feasible to meet the requirements of the law for a certain reduction of NO/sub x/ in flue gases from boilers within a foreseeable time. The often expressed opinion that only Japanese reduction processes can be used because of their quick availability, cannot be confirmed. In spite of the short development period of, at most, 3 years, individual German processes have reached, or nearly reached, the technical state. Thanks to wide development suitable and optimized separation processes will soon be available for all applications.

18138 (Juel-Conf—59, pp 40-45) **Development and testing of a measurement system for determining the NH/sub 3/ concentration after plant for NO/sub x/ separation in boiler plant.** Berkhahn, W. (Bodenseewerk Geosystem G.m.b.H., Ueberlingen, Germany, F.R.). Dec 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751936/JAW. (CONF-8610382—).

From BMFT status seminar: reducing nitrogen oxides from power stations; Juelich, F.R. Germany (1 Oct 1986).

A measurement system was developed for measuring NH/sub 3/ with a range of measurement of 0-20 ppm NH/sub 3/ in flue gas conditions. Considerable improvement of the previously available photometer SPECTRAN 677 was necessary for this purpose. Components were developed for sampling, whose temepratures are at least 250/sup 0/C and possibly 300/sup 0/C. There must be no cold point in the whole system, as deposits could occur here which would lead to blockage. If the deposits are carried to hot zones, they decompose, forming ammonia, so that the consequence would be uncontrollable memory effects.

18139 (Juel-Conf—59, pp 46-60) **Investigation of reduction of NO/sub x/ on pyrolysis coke.** Schuler, J.; Baumann, H.; Klein, J. (Bergbau-Forschung G.m.b.H. Forschungsinstitut des Steinkohlenbergbauvereins, Essen, Germany, F.R.). Dec 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751936/JAW. (CONF-8610382—).

From BMFT status seminar: reducing nitrogen oxides from power stations; Juelich, F.R. Germany (1 Oct 1986).

The NO/sub x/ emitted by power stations is largely formed from the fuel nitrogen of the coal. The NO/sub x/ emission of combustion is decided by a large number of gas/solid reactions occurring in homogeneous and heterogeneous gas phases. The fuel nitrogen is split in the primary pyrolysis stage between the volatile components and the residual coke. In the gas phase, the coal nitrogen can be oxidized via the main intermediate products HCN and NH/sub 3/ to NO/sub x/. The nitrogen remaining in the residual coke is oxidized to NO/sub x/ in the heterogeneous oxidation reaction. NO/sub x/ formed, can be reduced by homogeneous gas phase reactions with NH/sub 3/ and HCN, but can be reduced to N/sub 2/ in the carbon of the residual coke.

18140 (Juel-Conf—59, pp 61-76) **Laser measurement technique and mathematical simulation of measures for NO/sub x/ reduction in the context of the TECFLAM project.** Wolfrum, J. (Heidelberg Univ., Germany, F.R. Physikalisch-Chemisches Inst.). Dec 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751936/JAW. (CONF-8610382—).

From BMFT status seminar: reducing nitrogen oxides from power stations; Juelich, F.R. Germany (1 Oct 1986).

The research work concerns direct examination of the chemical element reactions concerned, the development and testing of realistic kinetic models, together with a suitable control and measurement technique and the development of multi-stage burners for reducing nitrogen oxides from nitrogen bound in the fuel.

18141 (Juel-Conf—59, pp 77-91) **Reduction of SO/sub 2/ and particularly of NO/sub x/ emission from coal firing by using coal pellets.** Paersch, M.J.; Franke, F.H. (Deutsche BP Benzin und Petroleum A.G., Hamburg, Germany, F.R.). Dec 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751936/JAW. (CONF-8610382—).

From BMFT status seminar: reducing nitrogen oxides from power stations; Juelich, F.R. Germany (1 Oct 1986).

Sorted coal nuts are usually used in small and medium sized boiler plants. A product equivalent to nuts can be produced by the agglomeration of cheap fine coal. The pelletting of coal is a suitable cheap process for this. Pellets were tested in a laboratory grate and on a large travelling grate. An experiment with stationary fluidized-bed firing was also carried out. The emission of SO/sub 2/ and NO/sub x/ can be appreciably reduced by the additive added to the pellets.

18142 (Juel-Conf—59, pp 92-108) **Dust firing low in NO/sub x/ with combustion chamber air stages at the Leiningerwerk power station unit 5 of the Isar-Amperwerke.** Schranner, M. (Isar-Amperwerke A.G., Muenchen, Germany, F.R.). Dec 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751936/JAW. (CONF-8610382—).

From BMFT status seminar: reducing nitrogen oxides from power stations; Juelich, F.R. Germany (1 Oct 1986).

This boiler of unit 5 is erected with single draught and is equipped with dry firing. The coal dust firing is marked by Boxer arrangement of 20 burners at 5 levels, where each of the burner levels is supplied with coal dust from its own mill. According to the aim of finding an environmentally acceptable power station design, burners low in NO/sub x/ were selected. Babcock eddy burners with stepped secondary air supply were used. Due to the distant site of the power station, the firing plant was designed for using a wide range of coals.

18143 (Juel-Conf—59, pp 109-138) **Investigation of coal dust firing with multiple stage combustion for greatly reduced nitrogen oxides.** Schreier, W.; Rennert, K.D. (Steinmueller, L.u.C. G.m.b.H., Gummersbach, Germany, F.R.). Dec 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751936/JAW. (CONF-8610382—).

From BMFT status seminar: reducing nitrogen oxides from power stations; Juelich, F.R. Germany (1 Oct 1986).

The possibility of reducing the NO/sub x/ by fuel grading was examined in an experimental plant with a burner with a thermal output of 15 MW. The experimental burner had a variable geometry, so that parameter studies could be made for optimising the process and for burner design. 4 coals of different composition and reactivity, one each of coking coal, gas flame coal, gas coal and brown coal is fired. The best results were obtained for highly volatile coals.

18144 (Juel-Conf—59, pp 139-161) **Development of technology for primary side reduction of NO/sub x/ in gas fired boilers.** Wiese, D. (Dampfkessel und Maschinenbau Ferdinand Lentjes, Duesseldorf, Germany, F.R.). Dec 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751936/JAW. (CONF-8610382—).

From BMFT status seminar: reducing nitrogen oxides from power stations; Juelich, F.R. Germany (1 Oct 1986).

The following conclusions can be drawn from experience in using the HERENOX process on 2 boilers for gas firing: 1. The components can easily be integrated if fitted later because of the low flue gas return rate. 2. The investment and running costs are at a relatively low level. 3. Depending on the type of boiler and extent of conversion, the potential NO/sub x/ reduction is up to 80%. 4. In particularly favourable conditions, one can do without additional flue gas denitrification by catalysts. In boilers fired with heavy oil, NO/sub x/ reductions of 50% can be achieved with the process.

18145 (Juel-Conf—59, pp 162-183) **Development of an economical process for simultaneous desulfurization and denitrification of flue gases.** Sodec, F. (Krantz, H. G.m.b.H. und Co., Aachen, Germany, F.R.). Dec 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751936/JAW. (CONF-8610382—).

From BMFT status seminar: reducing nitrogen oxides from power stations; Juelich, F.R. Germany (1 Oct 1986).

A dry process is described in which sulfur oxide and nitrogen oxide of the flue gases are adsorbed or removed catalytically when flowing through a heap of active carbon. The flue gases can be simultaneously desulfurised and denitrified in a reactor.

18146 (Juel-Conf—59, pp 192-206) **Experimental plant for catalytic reduction of nitrogen oxide emission by the Mannesmann/Steuler process after a hard coal-fired fusion boiler at the Westfalen power station.** Poller, J. (Vereinigte Elektrizitaetswerke Westfalen A.G., VEW, Dortmund, Germany, F.R.). Dec 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751936/JAW. (CONF-8610382—).

From BMFT status seminar: reducing nitrogen oxides from power stations; Juelich, F.R. Germany (1 Oct 1986).

In the field of selective catalytic reduction of nitrogen oxide, the use of molecular sieve catalysts offers an interesting alternative to metal doped catalysts. The advantages include the fact that there can be no deactivation of these components due to the failure of catalytic metal components, and the removal of used catalysts is considerably simplified. One also expects a lower SO/sub 2//SO/sub 3/ conversion rate even for use at high temperatures. Against the background of backfitting in existing power station units with fusion boilers, for which there are no references anywhere, an experimental plant for the catalytic reduction of nitrogen oxides was erected after a coal fusion boiler. When setting out the aims of the experiment, the problems and uncertainties regarding design and construction of large plants were seen on the high dust side. The circuit of the experimental plant therefore corresponds to the testing of this variant.

18147 (Juel-Conf—59, pp 207-238) **Catalytic NO/sub x/ reduction in power station exhaust gases with iron oxide-chromium oxide catalysts.** Kainer, H.; Flockenhaus, C. (Didier-Werke A.G., Wiesbaden, Germany, F.R.; Didier Engineering G.m.b.H., Essen, Germany, F.R.). Dec 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751936/JAW. (CONF-8610382—).

From BMFT status seminar: reducing nitrogen oxides from power stations; Juelich, F.R. Germany (1 Oct 1986).

A series of catalysts on the basis of iron-chromium oxide was developed and tested in pilot plants of several power station operators under very different conditions. Laboratory and college reactors were used for selecting materials. Layer, plate and honeycomb catalysts have been successfully tested.

18148 (Juel-Conf—59, pp 239-252) **New combined catalytic process for reducing the NO/sub x/ and SO/sub 2/ emission from boiler exhaust gases.** Ohlms, N. (Stadtwerke Muenster G.m.b.H., Germany, F.R.). Dec 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751936/JAW. (CONF-8610382—).

From BMFT status seminar: reducing nitrogen oxides from power stations; Juelich, F.R. Germany (1 Oct 1986).

The hot flue gas with dust extracted is taken through a reactor in this process, in which the following are provided: in the upper part, a three way catalyst for the reduction of NO/sub x/ to N/sub 2/, CO/sub 2/ and H/sub 2/O using natural gas as the means of reduction, in the central part, a heat exchanger to reduce the heat produced by the combustion of the remaining oxygen content in the flue gas in the RENOX stage, in the lower part, an 'oxidation catalyst' for oxidising SO/sub 2/ to SO/sub 3/, which forms sulfuric acid with the steam present in the flue gas and finally, another heat exchanger.

18149 (Juel-Conf—59, pp 277-286) **Desulfurization and denitrification of flue gases.** Storp, K. (Lurgi G.m.b.H., Frankfurt am Main, Germany, F.R. Lab. fuer Adsorptionstechnik). Dec 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751936/JAW. (CONF-8610382—).

From BMFT status seminar: reducing nitrogen oxides from power stations; Juelich, F.R. Germany (1 Oct 1986).

A simultaneous process is introduced, whose end products are sulfur and nitrogen, and which complies with the legal requirements. There are optimum conditions for separating NO/sub x/ and SO/sub 2/ on an adsorption catalyst at a reaction temperature of 70-80/sup 0/C. NO/sub x/ is oxidized better and bound to Al/sub 2/O/sub 3/ in the presence of SO/sub 2/. SO/sub 2/ which exist in high concentrations in the flue gas, is bound to the Al/sub 2/O/sub 3/ until the breakdown of the NO/sub x/ and is then bound in the subsequent active carbon layer as sulfuric acid to reduce it to the legally required concentration. The reduction of sulfate to sulfur and nitrate to N/sub 2/ is done at a temperature of 150/sup 0/C with hydrogen sulfide. The necessary hydrogen sulfide is formed by taking hydrogen over the active carbon containing sulfur and is used for the desorption of the sulfur from Al/sub 2/O/sub 3/ at 300 to 350/sup 0/C.

18150 (Juel-Conf—59, pp 287-299) **SHL process for the simultaneous separation of SO/sub 2/ and NO/sub x/ from the flue gases.** Form, M.; Gresch, H.; Gross, M.; Mueller, D. (Hoelter G.m.b.H., Gladbeck, Germany, F.R.). Dec 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751936/JAW. (CONF-8610382—).

From BMFT status seminar: reducing nitrogen oxides from power stations; Juelich, F.R. Germany (1 Oct 1986).

The process from Saarberg-Hoelter-Lurgi for the simultaneous removal of SO/sub 2/ and NO/sub x/ from flue gases is based on the absorption of the gas components in an aqueous solution, together with a reduction of the NO. The SO/sub 2/ of the flue gas acts as the means of reduction, where the solubility of the NO is guaranteed by adding a metal-chelate compound. The absorption process is done in a washer similar to REA at the steam saturation temperature of the flue gas, i.e. depending on the type of coal between 45/sup 0/C and 65/sup 0/C. In a preferred variant, CaSO/sub 4/ x 2H/sub 2/O of a quality comparable to flue gas desulfurization plants based on CaO or CaCO/sub 3/ is the end product. The separation and further treatment of the gypsum are done with conventional equipment.

18151 (Juel-Conf—59, pp 300-315) **Ballast hard coal fired power station low in NO/sub x/ with compound combustion.** Hannes, K. (STEAG A.G., Essen, Germany, F.R.). Dec 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751936/JAW. (CONF-8610382—).

From BMFT status seminar: reducing nitrogen oxides from power stations; Juelich, F.R. Germany (1 Oct 1986).

The primary and secondary combustion measures developed in Germany, have made so much progress recently that one can expect that these measures will reach about 400 mg NO/sub x//m/sup 3/ in new boilers. These devices cannot be fitted in old plant with the same success, as construction changes can only be achieved to a limited extent. In secondary reduction processes, the local and factual forces do not permit certain processes in planning.

18152 (Juel-Conf—59, pp 184-191) **NO/sub x/ conversion on active carbon after a gas fired power station unit.** Seipenbusch, J. (Petersen, H. G.m.b.H. und Co. K.G., Wiesbaden, Germany, F.R.). Dec 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751936/JAW. (CONF-8610382—).

From BMFT status seminar: reducing nitrogen oxides from power stations; Juelich, F.R. Germany (1 Oct 1986).

A part flow of the flue gas from the gas-fired power station boiler is tapped off from the main flue gas duct and is blown to the active carbon reactor. The connection for the NO/sub x/ crude gas analyser and a flow orifice with pressure and temperature measurement for converting the flow to standard conditions are situated on the blower suction side in the direction of gas flow. Part of the flue gas is returned from the blower pressure side to the suction side, to which ammonia has been added. The crude gas enters the front gas distribution chamber of the active carbon reactor from above, which is separated from the active carbon bed by guide sheets arranged like shutters, flows through the active carbon bed in the horizontal direction, and is drawn off from the rear gas collection chamber upwards from the reactor.

18153 **(Juel-Conf—59) Reducing nitrogen oxides from power stations. State-of-the-art and perspectives of research. Proceedings.** Scheller, W. (comp.). (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projektleitung Biologie, Oekologie, Energie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1986. 326p. (In German). (CONF-8610382—). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751936/JAW.

From BMFT status seminar: reducing nitrogen oxides from power stations; Juelich, F.R. Germany (1 Oct 1986).

The report contains 17 individual lectures of the seminar included in databanks. The lectures concern combustion and waste gas measures for reducing the sulfur dioxide and nitrogen oxide emission from coal-fired and gas-fired power stations.

18154 (Juel-Conf—59, pp 253-276) **Separation of NO/sub x/ and SO/sub x/ with the help of the electron beam process.** Fuchs, P.; Roth, B.; Schwing, U. (Badenwerk A.G., Karlsruhe, Germany, F.R.). Dec 1986. (In German). NTIS (US Sales Only), PC A15/MF A01. Order Number DE88751936/JAW. (CONF-8610382—).

From BMFT status seminar: reducing nitrogen oxides from power stations; Juelich, F.R. Germany (1 Oct 1986).

The electron beam process is mainly based on the conversion of the harmful molecules SO/sub 2/ and NO/sub x/ into the corresponding acids by irradiation with electrons. These acids are converted into salts by a suitable means of neutralisation and are separated from the flue gas. The reactions occur mainly in the gas phase. The product occurs in a dry solid form, so that there are no waste water problems with this process.

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REFER ALSO TO CITATION(S) 18008, 18027, 19364

18155 (NP—8770046, pp 1058-1067) **Research and development of distributed type new power generation technology.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is the 1985 annual report on the verification research made in the first year of the 6-year project. (1) To study the problems of power sources such as fuel cell, photovoltaic power generation, aerogeneration, etc. when linked to the electric power system, the research and development status and current problems for the power sources were put in order. (2) A model was made for a linked system of the distributed type systems connected to the electric power system, and technical problems were studied based on this model to obtain basic information for working out a demonstration system plan. The problems specifically pointed out during the study this time are regular voltage fluctuation, cooperation for protective measures, and preservation of security.

18156 (NP—8770077) **Development of methods for the analysis of frequency and voltage drop of electrical loads and networks.** Dollinger, J. (Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Elektrotechnik). 10 Mar 1986. 145p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88770077/JAW.

The consumers of electricity now make great demands regarding the reliability of supply and also the quality, i.e. constant voltage and frequency. In order to be able to guarantee the required quality, it is necessary to know the relationship of voltage and the power demand of the load. The work introduces two processes which, using newly developed measurement and data processing technique, permit certain information to be given on the effect of frequency and/or voltage on the power demand of part networks. They are based on different solutions and also offer the possibility of determining the relationship of any electrical parameters on the free variables voltage and frequency. Apart from the analyses of individual loads and of measurements in networks, the effects of drops of electrical loads on powerstation operation are described. (HAG).

18157 (DOE/SF/15784—T1) **A posture coordinating strategy for large electric power systems: Final technical report.** Thomas, R.J.; Tiranuchit, A. (Cornell Univ., Ithaca, NY (USA). School of Electrical Engineering). 1987. Contract FG03-85SF15784. 115p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005647/JAW.

This project is aimed at investigations into security issues of electric power networks. Two types of stability problems are studied: transient stability and voltage stability. For each type of stability problem, we derive a security index and feasible control strategies for maneuvering the system to a secure operating point. For transient stability we use the critical fault clearing time as the security index, and the control variables are the mechanical input power to each generator. We develop a continuation technique control that moves the system equilibrium to the operating point that yields the largest approximate critical clearing time for a given contingency. For static voltage stability problems, we propose to use the minimum singular value of the Jacobian as a voltage security index. Two control techniques are investigated. We examine the effect of VAR support on the minimum singular value index and identify favorable busses for placing compensation. The second control technique is the generation dispatch. We present a method that maximized the minimum singular value index with respect to the real and reactive generator power.

18158 (EPRI-EL—4540-CCM-Vol.8) **TLWorkstation code: Version 1.1: Volume 8, DYNAMP manual.** Black, W.Z. (Georgia Inst. of Tech., Atlanta (USA). School of Mechanical Engineering). Jan 1988. 71p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920176/JAW.

DYNAMP can perform both steady-state and transient ampacity calculations. There are three program options. The first program option involves a steady-state model which calculates a single value of the conductor temperature for constant weather conditions and a constant line current. The program also calculates ampacity for a given value of conductor limiting temperature. This type of model has been traditionally referred to as the House and Tuttle method. The second program option consists of a transient model for real-time conductor operation and it calculates instantaneous conductor temperatures when the conductor experiences varying current levels and weather conditions. The third program option provides predictive temperature calculations based on emergency situations that can arise from a sudden current overload on the line.

18159 (EPRI-EL—5291-Vol.2) **Reliability evaluation for large-scale bulk transmission systems: Volume 2, Functional specifications for a production-grade program: Final report.** Lam, B.P.; Lawrence, D.J.; Reppen, N.D.; Ringlee, R.J. (Power Technologies, Inc., Schenectady, NY (USA)). Jan 1988. 118p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920179/JAW.

This volume contains functional specifications for a production grade transmission reliability program. The specifications define the program structure, input and output requirements, and the required capabilities of the various program functions. Operating features and methods taken from the comparative evaluation and new methods assessment are defined. 25 figs., 13 tabs. (JDH)

18160 (EPRI-EL—5551-CCM-Vol.2) **Gas-insulated substations: Reliability Research Program: Volume 2, TLTA [Transmission Line Transients Analysis], Revision 2.4.0 user's manual.** Fujimoto, N. (Ontario Hydro Research Lab., Toronto (Canada)). Jan 1988. 52p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920167/JAW.

Equipment failure and consequent costly outages reduce the reliability of gas-insulated substations. This cooperative effort, cosponsored by EPRI, the Canadian Electrical Association, and seven utilities from the United States, Brazil, and Israel, identifies some of the mechanisms responsible for these failures and makes recommendations for improving equipment reliability. This volume is a user's manual for the computer code developed during the study.

18161 (EPRI-EL—5551-Vol.1) **Gas-insulated substations: Reliability Research Program: Volume 1, Operational characteristics and recommendations: Final report.** Boggs, S.A.; Chu, F.Y.; Collod, M.; Ford, G.L.; Fujimoto, N.; Harvey, S.; Stuckless, H.A. (Ontario Hydro Research Lab., Toronto (Canada)). Jan 1988. 187p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920166/JAW.

This volume contains a comparative evaluation of existing transmission system reliability programs (SYREL, GATOR, RECS) and relevant mathematical methods for transmission reliability analysis. Several new and enhanced methods in the areas of network analysis, contingency selection, remedial action, and reliability index calculation, developed and tested during the project, are described. Recommendations for methods to be used in a production grade transmission reliability assessment program are presented. 49 figs., 11 tabs.

18162 (ORNL/Sub—81-95011/3) **Electric power system harmonics design guide.** (McGraw-Edison Co., Canonsburg, PA (USA). Power Systems Div.). Sep 1987. Contract AC05-84OR21400. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006158/JAW.

Harmonics on the electric power system can cause motor overheating, capacitor failures, watthour meter error and relay malfunctions. The degree of problems caused by harmonics is greatly dependent on the characteristics of the power system. This guide provides useful reference information for designing power systems to minimize these potentially harmful effects. The guide is arranged topically, providing basic information on topics ranging from the origin of distortion on the power system to filter design. Harmonic-producing devices are described. Basic fundamentals of harmonics are presented in a way easily understood by electric power engineers. The differences between voltage distortion and current dis-

tortion, and their interactions with the power system, are explained. Particular attention is given to measurements and analysis, which are essential to successfully correcting problems due to harmonics. Finally, a trouble-shooting guide listing typical symptoms and solutions is provided. 3 refs.

18163 (PNL—6076) Customer system efficiency improvement assessment: Supply curves for transmission and distribution conservation options. Tepel, R.C.; Callaway, J.W.; De Steese, J.G. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1987. Contract AC06-76RL01830. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88003561/JAW.

This report documents the results of Task 6 in the Customer System Efficiency Improvement (CSEI) Assessment Project. A principal objective of this project is to assess the potential for energy conservation in the transmission and distribution (T&D) systems of electric utilities in the BPA service area. The scope of this assessment covers BPA customers in the Pacific Northwest region and all non-federal T&D systems, including those that currently place no load on the BPA system. Supply curves were developed to describe the conservation resource potentially available from T&D-system efficiency improvements. These supply curves relate the levelized cost of upgrading existing equipment to the estimated amount of energy saved. Stated in this form, the resource represented by T&D loss reductions can be compared with other conservation options and regional electrical generation resources to determine the most cost-effective method of supplying power to the Pacific Northwest. The development of the supply curves required data acquisition and methodology development that are also described in this report. 11 refs., 11 figs., 16 tabs.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 18237, 18845, 20553, 20555, 20600

18164 (IAEA-TECDOC—445) Small and medium power reactors 1987. (International Atomic Energy Agency, Vienna (Austria)). Dec 1987. 113p. NTIS (US Sales Only), PC A06/MF A01. Order Number TI88701435/JAW.

This TECDOC follows the publication of TECDOC-347 Small and Medium Power Reactors Project Initiation Study - Phase I published in 1985 and TECDOC-376 Small and Medium Power Reactors 1985 published in 1986. It is mainly intended for decision makers in Developing Member States interested in embarking on a nuclear power programme. It consists of two parts: 1) Guidelines for the Introduction of Small and Medium Power Reactors in Developing Countries. These Guidelines were established during the Advisory Group Meeting held in Vienna from 11 to 15 May 1987. Their purpose is to review key aspects relating to the introduction of Small and Medium Power Reactors in developing countries; 2) Up-dated Information on SMPR Concepts Contributed by Supplier Industries. According to the recommendations of the Second Technical Committee Meeting on SMPRs held in Vienna in March 1985, this part contains the up-dated information formerly published in Annex I of the above mentioned TECDOC-347. Figs.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 18209, 18244, 18254, 18276, 18277, 18282, 18284, 18285, 18295, 18296, 18297, 18298, 18299, 18300

18165 (BARC—1328) Failure investigation of stem of valve disc in reactor-recirculation system of TAPS Unit-1. Ramadasan, E.; Bahl, J.K.; Sivaramakrishnan, K.S. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703141/JAW.

Failure analysis was carried out of failed 17-4 PH stainless steel stem of the valve disc in reactor recirculation system of Unit-1 of Tarapur Atomic Power Station. The examination revealed that the stem failed due to fatigue, accelerated by corrosion. Recommendations have been made to avoid such failures. 4 references, 8 figures.

18166 (CONF-8710111—27) Effects of irradiation on strength and toughness of commercial LWR vessel cladding. Haggag, F.M.; Corwin, W.R.; Alexander, D.J.; Nanstad, R.K. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004701/JAW.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The potential for stainless steel cladding to improve the fracture behavior of an operating nuclear reactor pressure vessel, particularly during certain overcooling transients, may depend greatly on the properties of the irradiated cladding. Therefore, weld overlay cladding irradiated at temperatures and to fluences relevant to power reactor operation was examined. The cladding was applied to a pressure vessel steel plate by the three-wire series-arc commercial method. Cladding was applied in three layers to provide adequate thickness for the fabrication of test specimens. The three-wire series-arc procedure, developed by Combustion Engineering, Inc., Chattanooga, Tennessee, produced a highly controlled weld chemistry, microstructure, and fracture properties in all three layers of the weld. Charpy V-notch and tensile specimens were irradiated at 288°C to fluence levels of 2 and 5 x 10^{19} neutrons/cm^2 (>1 MeV). Postirradiation testing results show that, in the test temperature range from -125 to 288°C, the yield strength increased by 8 to 30%, ductility insignificantly increased, while there was almost no change in ultimate tensile strength. All cladding exhibited ductile-to-brittle transition behavior during Charpy impact testing, due to the dominance of delta-ferrite failures at low temperatures. On the upper shelf, energy was reduced, due to irradiation exposure, 15 and 20%, while the lateral expansion was reduced 43 and 41%, at 2 and 5 x 10^{19} neutrons/cm^2 (>1 MeV), respectively. In addition, radiation damage resulted in 13 and 28°C shifts of the Charpy impact transition temperature at the 41-J level for the low and high fluences, respectively.

18167 (DOE/ET/34205—34) Chemical cleaning of Dresden Unit 1: Final report. (IT Corp., Knoxville, TN (USA); Commonwealth Research Corp., Chicago, IL (USA)). May 1986. Contract AC02-76ET34205. 319p. NTIS, PC A14/MF A01. Order Number DE88005484/JAW.

The introduction of NS-1 solvent into the full primary system of Dresden Unit-1 nuclear power reactor on September 12, 1984, represented the culmination of several years of development, testing, planning, and construction. The requirement was to dissolve the highly radioactive deposits of primarily nickel ferrite without any corrosion which might compromise the reactor systems. During the actual cleaning with the NS-1 solvent, the chemical condition of the circulating solvent was measured. Iron, nickel, and radioactive cobalt all dissolved smoothly. The amount of copper in solution decreased in concentration, verifying expectations that metallic copper would plate on to clean metal surfaces. A special rinse formulation was employed after the primary cleaning steps and the "lost" copper was thus redissolved and removed from the system. After the cleaning was complete and the reactor had been refilled with pure water, radiation levels were measured. The most accurate of these measurements gave decontamination factors ranging well above 100, which indicated a significant removal of the radioactive deposits, and demonstrated the success of this project. Treatment of the radioactive liquid wastes from this operation required volume reduction and water purification. The primary method of processing the spent cleaning solvent and rinse water was evaporation. The resulting concentrate has been stored as a liquid, awaiting solidification to allow burial at a designated site. Water which was separated during evaporation, along with the dilute rinses, was processed by various chemical means, reevaporated, treated with activated carbon, and/or demineralized before its radionuclide and chemical content was low enough to allow it to be returned to Dresden Station for treatment or disposal. 60 figs., 31 tabs.

18168 (EPRI-NP—5590) Microstructural examination of fatigue accumulation in critical LWR [light water reactor] components: Final report. Allen, A.J.; Buttle, D.J.; Coleman, C.F.; Smith, F.A.; Smith, R.L. (UKAEA Harwell Lab. Materials Physics and Metallurgy Div.). Jan 1988. 101p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920159/JAW.

This report describes a morphological study of the feasibility of measuring the fatigue damage accumulation state of critical light water reactor (LWR) components by microstructural examination. The changes in microstructure associated with fatigue processes are first discussed so that relevant NDE measurement parameters can be identified. (The creep regime is not considered in this report). The candidate NDE techniques are then reviewed in detail under the following headings: positron annihilation, x-ray diffraction, magnetic techniques, the magnetic Barkhausen effect, the magneto acoustic technique, acoustic emission, ultrasonic techniques and finally other miscellaneous techniques applicable to fatigue damage assessment. All the feasible techniques are summarised and rated in a set of comparison tables. A possible programme for the immediate development of the positron annihilation lineshape technique is proposed. It is concluded that the most successful method of measuring the fatigue accumulation in LWR critical components in a way which relates to the intent of the ASME pressure vessel codes, is likely to be the use of several techniques together and the cross-relation of the results obtained by each. Five techniques are highlighted for immediate possible development: 'etching and surface replication', 'positron annihilation lineshapes', 'x-ray diffraction residual stress', 'acoustic emission' and 'ultrasonic surface acoustic waves'.

18169 (EPRI-NP—5591) Precipitate stability in Zircaloy-4: Final report. Yang, W.J.S. (General Electric Co., San Jose, CA (USA)). Jan 1988. 77p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920160/JAW.

Zircaloy-4, a zirconium base alloy used extensively as cladding and core structural materials in water-cooled nuclear reactors, was examined by transmission electron microscopy after quench-and-aging treatments, neutron irradiation and postirradiation annealing. Phase instabilities found after quench-and-aging treatments include: (1) formation of the metastable precipitate $Zr_4(Fe,Cr)$ during quench from the β-phase field and (2) dissolution of metastable $Zr_4(Fe,Cr)$ and formation of the stable precipitate $Zr(Fe,Cr)_2$ during aging in the α-phase field after quench. Rapid precipitation of $Zr(Fe,Cr)_2$ occurs on aging at 750°C. Phase instabilities found after irradiation include amorphous transformation and dissolution of intermetallic $Zr(Fe,Cr)_2$ in the α-recrystallized matrix and dissolution of the metastable precipitate $Zr_4(Fe,Cr)$ in the β-quenched matrix. A complete solid solution is achieved in the irradiated, β-quenched matrix. Solute supersatuation in the matric is maintained to high fluences without new precipitation and segregation. Supersaturated Fe in the matric precipitates out at grain boundaries as the Zeta-phase during postirradiation annealing at 560°C. Both Cr and Fe precipitate out as $Zr(Fe,Cr)_2$ intermetallics on annealing at 750°C. In addition to the phase instabilities, irradiation also causes anti c dislocation development and grain growth by grain boundary migration.

18170 (FRCEA-TH—24) Achievement and qualification of multigroup cross-section library for light water reactor calculation. Gastaldi, B. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. des Reacteurs a Eau; Paris-11 Univ., 91 - Orsay (France)). Jul 1986. 203p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE87753193/JAW.

This study intends to improve then to check on integral experiments, the calculation of the main neutronic parameters in light water moderated lattices: Uranium 238 capture and consequently Plutonium 239 build-up, multiplication factor, temperature coefficient. The first part of this work concerns the resonant reaction rate calculation method implemented in the APOLLO code, the so-called LIVOLANT and JEANPIERRE formalism. The errors introduced by the corresponding assumptions are quantified and we propose substitution methods which avoid large biases and supply satisfactory results. The second part is dedicated to the cross-section evaluation of uranium major isotopes and to the achievement of APOLLO multigroup cross-sections. This cross-section set takes into considerations on the one hand the recent differential information and the other hand the various integral information obtained in the French Atomic Energy Commission facilities. The nuclear data file (JEF abd ENDF/B5) processing, for multigroup and self-shielded cross-sections achieving enable us to check the new THEMIS computer code. In the last part, the experimental validation of the proposed procedure (accurate formalism mutuel shielding and new multigroup library) is presented. This qualification is based on the reinterpretation of critical experiments performed in the EOLE reactor at Cadarache and spent fuel analysis. The corresponding results demonstrate that our propositions provide improvements on the computation of the PWR neutronic parameters; calculation-experiment discrepancies are now consistent with experimental uncertainty margins. 46 refs; 31 figs; 23 tabl.

18171 (KFK—4177, pp 412-441) Further development of the methods for calculating the nuclear inventory of burnt-up nuclear fuels at KfK. Broeders, C.; Wiese, H.W. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Neutronenphysik und Reaktortechnik). Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

In order to determine the nuclear inventory of burnt-up nuclear fuels from thermal and fast reactors, the computer program KORIGEN and the multi-dimensional program system KARBUS were developed as further developments including the provision of consistent effective cross sections at INR of KfK. With the new KARBUS process, using the latest nuclear basic data for actinides, fission products and structural materials, spectrum and burn-up calculations can be done, taking into account the fuel changing processes for actual reactors, even those with an epithermal neutron spectrum. The checking of KORIGEN and KARBUS by experimental post-irradiation investigations and integral experiments leads to the result that KORIGEN (in the context of its data files) and KARBUS can be reliably used over a wide spectrum of applications, including for fuel with recycled plutonium and uranium. Recent successful applications of KARBUS or of individual KARBUS modules were found for questions of PU return and the activation of fuel element end pieces in PWR's. The fast reactor part of KARBUS was used in extensive inventory calculations for SNR 300, which included the determination of the post-shutdown heat with an accuracy analysis.

18172 (NUREG—0313-Rev.2-Final) Technical report on material selection and processing guidelines for BWR [boiling water reactor] coolant pressure boundary piping: Final report. Hazelton, W.S.; Koo, W.H. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering and System Technology). Jan 1988. 45p. NTIS, PC A03/MF A01 - GPO. Order Number TI88900309/JAW.

This report provides the technical bases for the NRC staff's revised recommended methods to control the intergranular stress corrosion cracking susceptibility of BWR piping. For piping that does not fully comply with the material selection, testing, and processing guideline combinations of this document, varying degrees of augmented inservice inspection are recommended. This revision also includes guidance and NRC staff recommendations (not requirements) regarding crack evaluation and weld overlay repair methods for long-term operation or for continuing interim operation of plants until a more permanent solution is implemented.

18173 (NUREG/CR—5048) Review of the natural circulation effect in the Vermont Yankee spent-fuel pool. Wheeler, C.L. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1988. Contract AC06-76RL01830. 142p. (PNL—6388). NTIS, PC A07/MF A01 - GPO. Order Number TI88006564/JAW.

A 7429-node, three-dimensional computer model of the Vermont Yankee spent-fuel pool was set up and run using the porous media model of the TEMPEST computer code. The results of this

analysis show that natural circulation is sufficient to ensure adequate cooling, regardless of the loading pattern used or the orientation of the cooling system discharge nozzle.

18174 Radiation effects on microelectronics. Gover, J.E. (Sandia National Lab., Albuquerque, NM). *Transactions of the American Nuclear Society;* **54**: 14-15(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

Applications of radiation-hardened microelectronics in nuclear power systems include (a) light water reactor (LWR) containment building, postaccident instrumentation that can operate through the beta and gamma radiation released in a design basis loss-of-coolant accident; (b) advanced LWR instrumentation and control systems employing distributed digital integrated circuit (IC) technology to achieve a high degree of artificial intelligence and thereby reduce the probability of operator error under accident conditions; (c) instrumentation, command, control and communication systems for space nuclear power applications that must operate during the neutron and gamma-ray core leakage environments as well as the background electron, proton, and heavy charged particle environments of space; and (d) robotics systems designed for the described functions. Advanced microelectronics offer advantages in cost and reliability over alternative approaches to instrumentation and control. No semiconductor technology is hard to all classes of radiation effects phenomena. As the effects have become better understood, however, significant progress has been made in hardening IC technology. Application of hardened microelectronics to nuclear power systems has lagged military applications because of the limited market potential of hardened instruments and numerous institutional impediments.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 18166, 18168, 18170, 18171, 18174, 18209, 18221, 18234, 18236, 18240, 18241, 18245, 18254, 18259, 18265, 18268, 18273, 18280, 18282, 18284, 18287, 18293, 18295, 18296, 18297, 18298, 18300, 18306, 18307, 18308, 18315, 18316, 18317, 18318, 18319, 18320, 18321, 18617, 18724

18175 (CEA-CONF—9142) Human factor in the design and operation of French light water nuclear power plants. Gomolinski, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Oct 1986. 25p. (In French and English). (CEA-DAS—352; CONF-8610381—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751863/JAW.

From Franco-Sovietic seminar on safety of the light water reactors; Fontenay-aux-Roses, France (12 Oct 1986).

The accident which occurred at Three Mile Island (TMI 2) on March 28, 1979 is considered rightfully as the outset of the approach taking the human factor explicitly into account in nuclear safety, both in the design of the plants and in their operational use. In this paper, we shall endeavour to explain how this human factor has been taken into account in France. For this purpose, in the first part, we shall define the requirements, i.e. describe the sectors in which improvements were deemed necessary. In the second part, we shall describe the structures set up both at EDF and at the CEA to handle these problems. Lastly, in the third part, we shall describe the principal actions taken or in progress.

18176 (CEPN—111) Multi-attribute analysis of options for steam generator repair. Lombard, J. (Centre d'Etude sur l'Evaluation de la Protection dans le Domaine Nucleaire, 92 - Fontenay-aux-Roses (France)). Sep 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753181/JAW.

The nuclear power plant at Beznau suffers from the appearance of leaks in numerous steam generator tubes. During the second year of operation of unit I (1971), all tubes located in certain particularly threatened areas of steam generators were plugged as a preventive measure to prevent a non-scheduled shutdown of the facility. Under certain circumstances, the number of tubes currently plugged at this time requires the power of the installation to be reduced. For this reason, work started in 1981 to reactivate some of the tubes plugged as a preventive measure. This work costs an annual collective dose of approximately 60 man.rems (0.6 man.Sieverts) (dose rate in a steam generator water chamber: approximately 15 rems/hour). This situation poses the question of whether the method implemented (annual repairs) is an optimum procedure. An option, mentioned by the monitoring authority and the utility, consists in repair by one step following decontamination of the water chamber of steam generators. In addition, the replacement of steam generators is the subject of discussion and design studies. Therefore three options are available for the Beznau power plant; this report presents and analyses them.

18177 (ENEA-RT-PAS—85-28) Evaluation of activity and dose analysis of shielding systems in view of Garigliano Reactor decommissioning. Picini, P.; Tomassini, T. (ENEA, Rome (Italy)). 1985. 64p. (In Italian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88701271/JAW.

In this work MERCURE-IV code has been used to calculate the dose rate inside the vessal of Garigliano Nuclear Power Plant. Moreover the layers of lead necessary to reduce the dose rate to values less than 2 mrem/h in various operational conditions have been calculated for the case of vessel removal handling operations.

18178 (EPRI-NP—5503) Library of PWR [pressurized-water reactor] steam generator tubing samples: Final report. Albertin, L.; Clark, W.G. Jr.; Junker, W.R.; Kuchirka, P.J.; Madeyski, A.; Metala, M.J.; Taszarek, B.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Jan 1988. 243p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920155/JAW.

The PWR Steam Generator Tubing Sample Library is a Steam Generator Owners Group-EPRI program whose objective is to compile a library of well-characterized tubing samples to be used for performance evaluation of inspection systems and for training and qualification of signal interpretation systems. The library was created through the preparation of samples intended to replicate degradation encountered in actual field tubes. A limited number of tube segments removed from actual steam generators are included. Degradation categories include wear, pitting and fatigue cracks, as well as stress corrosion cracking (SCC) and intergranular attack (IGA). Eddy current and ultrasonic inspection techniques, along with supplementary radiography, dye penetrant, and optical techniques were used to characterize the library candidates. Advanced computer-aided NDE data collection, analysis and display techniques were used to assess test results. This report provides details of the library program, with major emphasis on the sampling protocol, characterization of degradation and recommendations for the use and future growth of the library. Also included is a compendium of steam generator tube degradation field observation, describing past destructive examinations of tubes removed for inspection from steam generators, and a description of a physical modeling approach, using mercury (metal) to assess the discontinuity characterization capabilities of a pancake-type eddy current probe. Computerized data analysis and display techniques were used to reconstruct the test results in both two-dimensional color-coded maps and three-dimensional pseudo-isometric plots.

18179 (EPRI-NP—5563-Vol.1) NDE and mechanical removal of sludge in PWR steam generators: Volume 1, Overview and utility experiences: Final report. Chick, E.E.; Turner, A.P.L.; Gerdingh, R.F.; D'Silva, N. (Dominion Engineering, Inc., McLean, VA (USA); LN Technologies Corp., Columbia, SC (USA)). Jan 1988. 112p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920150/JAW.

A study was made to identify the needs of utilities for detecting, measuring, and mechanically removing sludge and related corrosion products from PWR steam generators, both recirculating U-tube and once through designs. The study determined, from the utility-user viewpoint, how well these needs are being met by currently available technology; identified opportunities for improvement; and made recommendations for research efforts to realize these opportunities. Methods for chemically removing sludge and corrosion products from steam generators, i.e., use of chemical sol-

vents, were not addressed. Reports from nuclear steam supply system vendors and independent service vendors on their current processes and prior developmental efforts with mechanical removal methods and NDE techniques are included in the study. In addition, information was obtained from the technical literature and from discussions and visits with knowledgeable individuals at utilities, service vendors, and engineering and consulting firms. Current removal methods examined included sludge lancing, pressure pulse and water slap; current NDE techniques examined included eddy current, optical instruments, sludge sampling, and water balance measurements. Additional NDE techniques reported on by the service vendors included Hall effect and magnetic field sensing probes, ultrasonic, and radiation attenuation techniques.

18180 **(EPRI-NP—5563-Vol.2) NDE and mechanical removal of sludge in PWR steam generators: Volume 2, Vendor practices: Final report.** Kidd, C.C.; Scharton, T.D.; Spencer, R.B.; Taylor, G.B.; Stewart, D.R.; Gallagher, M.J.; Johnson, L.E.; Sapia, M.A.; Edwards, L.J.; Dashukewich, M.L. (Anco Engineers, Inc., Culver City, CA (USA); Babcock and Wilcox Co., Lynchburg, VA (USA). Nuclear Power Div.; Combustion Engineering, Inc., Windsor, CT (USA); Foster-Miller, Inc., Waltham, MA (USA); Westinghouse Electric Corp., Pittsburgh, PA (USA). Power Systems Business Unit). Jan 1988. 450p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920152/JAW.

A study was made to identify the needs of utilities for detecting, measuring, and mechanically removing sludge and related corrosion products from PWR steam generators, both recirculating U-tube and once through designs. The study determining, from the utility-user viewpoint, how well these needs are being met by currently available technology; identified opportunities for improvement; and made recommendations for research efforts to realize these opportunities. Methods for chemically removing sludge and corrosion products from steam generators, i.e., use of chemical solvents, were not addressed. Reports from nuclear steam supply system vendors and independent service vendors on their current processes and prior developmental efforts to realize these opportunities. Methods for chemically removing sludge and corrosion products from steam generators, i.e., use of chemical solvents, were not addressed. Reports from nuclear steam supply system vendors and independent service vendors on their current processes and prior developmental efforts with mechanical removal methods and NDE techniques are included in the study. In addition, information was obtained from the technical literature and from discussions and visits with knowledgeable individuals at utilities, service vendors, and engineering and consulting firms. Current removal methods examined included sludge lancing, pressure pulse and water slap; current NDE techniques examined included eddy current, optical instruments, sludge sampling, and water balance measurements. Additional NDE techniques reported on by the service vendors included Hall effect and magnetic field sensing probes, ultrasonic, and radiation attenuation techniques.

18181 **(EPRI-NP—5621) Cleanup of steam cycle drains in PWRs [pressurized water reactors] with once-through steam generators: Final report.** Schlesinger, H.; Chakravorti, R.K.; Siegwarth, D.P. (Gibbs and Hill, Inc., San Jose, CA (USA); NWT Corp., San Jose, CA (USA)). Jan 1988. 55p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920172/JAW.

Ionic contaminants in pressurized water reactor feedwater promotes corrosion of steam generators, and turbine discs and blades. Ionic contaminants which concentrate in once-through steam generator (OTSG) moisture separator drains are a direct source of ionic contaminants in the feedwater. Specifications and cost estimates for an OTSG moisture separator drain cleanup system which uses heat exchangers for heat recovery and ion exchange for contaminant removal are given in this report. 5 refs., 15 figs., 12 tabs.

18182 **(EPRI-NP—5623) Oxygen control in PWR makeup water: Final report.** Sadler, M.A.; Darvill, M.R. (Central Electricity Generating Board, Bristol (UK). Operating Engineering Div.). Jan 1988. 64p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920178/JAW.

Three fixed bed methods for the removal of dissolved oxygen from boiler make-up water have been explored in rig tests employing 25 mm diameter columns with beds depths of 1000 mm. Processes examined include those based on palladium coated anion resin, Bayer OC1045, to catalyse the hydrazine/oxygen reaction, activated carbon to accelerate the hydrazine/oxygen reaction, and an experimental redox resin, Rohm and Haas XE239 which employs substituted hydroquinone functional groups. Short term tests show that all three approaches are effective in removing >98% of dissolved oxygen from nominally air saturated water at 21°C and at a flow of 24.5 BVh^{-1}. Available evidence indicates that final oxygen levels of <5 μgkg^{-1} (ppB) should be achievable by the use of these processes. Possible problems center mainly on the leakage, or predicted leakage of impurities from these beds although these should be overcome by the use of a final ion exchange stage. It is difficult to select any one process as all the systems have different advantages and disadvantages. Activated carbon based systems are, on balance, preferred in view of the wide availability of the material, its low cost, its effectiveness and possible side benefits such as removal of organics. Its potential for development, through the manufacture of pure forms of activated carbon from synthetic starting materials, is attractive as this should overcome impurity leakage problems experienced with current material. 13 refs., 15 figs.

18183 **(FRADOC—10-2) Design features and operating experience for reducing man rems in French PWR.** Dubourg, M. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Jun 1986. 10p. (CONF-860603—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751875/JAW.

From 4. European nuclear conference and 9. FORATOM congress (ENC '86) and international nuclear trade fair; Geneva, Switzerland (1 Jun 1986).

Operation of 900 MWe class PWRs in France and Belgium has shown that average collective radiation doses due to operation and maintenance are lower than those in other countries such as the United States of America. This can be explained by the fact that the design precautions taken by Framatome and the operating procedures established by the Electricite de France help to keep the dose levels low. As a result of R and D activities, Framatome has initiated concrete measures to help reduce personnel radiation exposure. These include reduction in the source and quantity of activable products, and in the duration of personnel exposure during maintenance. To reduce occupational radiation exposure, the following measures have been implemented: (1) reduction of the source and quantity of corrosion products susceptible to activation, and (2) reduction of maintenance personnel exposure time through adequate training before intervention on full-scale mock-ups and use of improved maintenance tooling. A better understanding of the migration process has been obtained by the development of analytical models and by the validation of these models by periodic dose field measurements on reactors. An optimized lithium hydroxide strategy for chemical control of the primary coolant is currently in use to reduce the deposition of corrosion products on equipment surfaces. Better specified materials used for the primary system and more stringent limitations on cobalt values for structural and fuel materials can also contribute to lower doses. The development of training on the decontamination system before intervention and use of maintenance tooling for servicing steam generator are also key-factors for reducing operating dose.

18184 **(FRADOC—10-4) Framatome RCVS concept and physics.** Vallee, A.; Millot, J.P.; Bruna, G. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Jun 1986. 10p. (CONF-860603—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751877/JAW.

From 4. European nuclear conference and 9. FORATOM congress (ENC '86) and international nuclear trade fair; Geneva, Switzerland (1 Jun 1986).

We have tried through this presentation to emphasize on what FRAMATOME thinks to be the most specific problems of the advanced RCVS (Reactor core with spectral shift) core concept (Spectral shift, voidage, reactivity control). Besides, FRAMATOME is analysing the most important safety related topics typically LOCA and DNBR, and has launched developments on them, in connection with CEA. The core behaviour during a loss of Coolant Accident is quite similar to PWR's, the pitch between rods being sufficiently large for clad ballooning not to cause any damage. To conclude, the core improvements developed by FRAMATOME on the RCVS concept economize the use of fissile materials.

18185 **(FRADOC—10-6) Evolution of design of Framatome pressurized water reactor systems.** Bitsch, D. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Jan 1986. 15p. (In French). (CONF-8601137—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751879/JAW.

From SFEN meeting on energy production from PWRs and breeders including thermonuclear fusion; Vincennes, France (28 Jan 1986).

This presentation has for objective to give a brief survey on the evolution of the Nuclear Steam Supply system (NSSS) of the French's PWR. The french program includes actually 63 units, 36 are connected on the power grid at the end of 1985. Progress features, resulting from the feedback of construction and operating experience and from the returns of a vast research and development program, were incorporated in their design through subsequent series of standard units. An example of this continuous progress is given through the last four loop standard, the N4 model. This model includes a new advanced fuel assemblies (AFA fuel), a new reactor control (Reactor Maximum Flexibility Package (RMAX or DMAX, dispositif maximise de Manoeuvrabilite Accrue, in French), a new steam generator with axial-mixed flow economizer and inconel 690 tubes and a new reactor coolant pump with performances and reliability increased.

18186 **(FRADOC—11-2) Extended fuel cycle length.** Bruyere, M.; Vallee, A.; Collette, C. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Sep 1986. 9p. (CONF-8609220—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751880/JAW.

From VGB-congress power plants '86 - VGB annual meeting; Strasbourg, France (2 Sep 1986).

Extended fuel cycle length and burnup are currently offered by Framatome and Fragema in order to satisfy the needs of the utilities in terms of fuel cycle cost and of overall systems cost optimization. We intend to point out the consequences of an increased fuel cycle length and burnup on reactor safety, in order to determine whether the bounding safety analyses presented in the Safety Analysis Report are applicable and to evaluate the effect on plant licensing. This paper presents the results of this examination. The first part indicates the consequences of increased fuel cycle length and burnup on the nuclear data used in the bounding accident analyses. In the second part of this paper, the required safety reanalyses are presented and the impact on the safety margins of different fuel management strategies is examined. In addition, systems modifications which can be required are indicated.

18187 **(IAE—4244/4) Possibility and importance of an analytical approach in analysis of stressed-deformed state of fuel elements for power reactors.** Zakharko, Yu.A.; Proshkin, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 28p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703197/JAW.

Methods for determining stressed-deformed state of fuel elements during fuel-cladding interaction are presented. A new approach to the formulation and solution of the problem describing fuel-element behavior, in the case if the creep rates for fuel and fuel can are linear functions of stresses, is used. Along with the general solution, approximate analytical solutions and criteria relations for preliminary estimations in designing and analysis of experimental data are presented. Test calculations of fuel-element behavior in WWER-type reactors are carried out. Analytical solutions and experimental data on profilometry of spent fuel elements are proved to be suitable for estimation of such hard-to-determine properties as fuel and fuel-can creep. 5 references.

18188 **(INIS-BR—918) Optimal sequence of the reload charge fuel enrichment to a reactor.** Sato, S. (Instituto Militar de Engenharia, Rio de Janeiro (Brazil)). 1975. 71p. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number TI88701459/JAW.

An optimal sequence of enrichment of the reload charge of a three regions PWR during its life has been determined by dynamic programming. The state of the reactor is specified by the burnup of the fuel in the three regions and their initial enrichments. Constraints were imposed on the power peaking factor, the maximum burnup, the length of each stage between refueling and the total life of the reactor. 'Central-scatter loading' was assumed at each reloading. The two group diffusion equations were solved by the modal method for the static calculations of the reactor. Otimization of enrichment of the reload charge was performed under several hypotheses on the variation of the costs of uranium, costs of enrichment and the plant factor during the reactor life. It was observed that the optimum enrichment of the reload fuel is influenced more by the cost of enrichment rather than plant factor or cost of uranium.

18189 (INIS-mf—11096, pp 226-247) **Steam turbine of WWER-1000 unit.** Drahy, J. (Skoda, Plzen, Czechoslovakia). 9 Dec 1986. (In Czech). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780047/JAW. (CONF-8610377—).

From Nuclear power day '86; Rez, Czechoslovakia (1 Oct 1986).

Published in two parts.

The manufacture was started by Skoda of a saturated steam, 1,000 MW, 3,000 rpm turbine designed for the Temelin nuclear power plant. The turbine provides steam for heating water for district heating, this either with an output of 893 MW for a three-stage water heating at 150/60 degC, or of 570 MW for a two-stage water heating at 120/60 degC. The turbine features one high-pressure and three identical low-pressure stages. The pressure gradient between the high-pressure and the low-pressure parts was optimized with respect to the thermal efficiency of the cycle and to the thermodynamic efficiency of the low-pressure part. A value of 0.79 MPa was selected corresponding to the maximum through-flow of steam entering the turbine. This makes 5,495 t/h, the admission steam parameters are 273.3 degC and 5.8 MPa. The feed water temperature is 220.9 degC. 300 cold starts, 1,000 starts after shutdowns for 55 to 88 hours and 600 starts after shutdown for 8 hours are envisaged for the entire turbine service life. (Z.M.). 5 figs., 1 tab., 6 refs.

18190 (INIS-mf—11096, pp 248-277) **Nuclear power and heating plants.** Kappel, J.; Valasek, J. (Energoprojekt, Prague, Czechoslovakia). 9 Dec 1986. (In Czech). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780047/JAW. (CONF-8610377—).

From Nuclear power day '86; Rez, Czechoslovakia (1 Oct 1986).

Published in two parts.

The principles are listed of heat extraction for district heating from Czechoslovak nuclear power plants at Jaslovske Bohunice, Dukovany, Mochovce and Temelin. The possible use of nuclear heating plants for covering the heat consumption diagram is briefly characterized. General problems are discussed of long-distance heat transport and of the actual heat supply systems, this with respect to their technical design and to their blending in the landscape. Special attention is paid to the economy of long-distance heat transport. In case of nuclear power sources, the economy is primarily affected by specific cost of building the heat supply pipelines, by hydraulic and pressure losses associated with long-distance heat transport, by possible reduction of air pollution and by substitution of expensive imported high-grade fuels. So-called surface lines are mostly envisaged for heat supply pipelines, i.e., pipelines mounted on short pillars immediately above groudn. (Z.M.). 3 figs., 3 tabs., 17 refs.

18191 **(INIS-mf—11634) Demonstration of plutonium recycling in LWR: Investigation of MOX fuel assemblies in different LWR. Final report.** Porsch, D.; Stach, W.; Schlosser, G. (Kraftwerk Union A.G., Erlangen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). 1987. 87p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752252/JAW.

Within this program the demonstration of Pu recycling was continued at KWO and started at GKN-1, KKU and KKG-BAG. A limited amount of MOX fuel assemblies (MOX-FA) was inserted in cores with different sizes and different load strategies. It was demonstrated that MOX fuel assemblies cause no restrictions in reactor operation. The MOX fuel assemblies can be designed for all specific reactor requirements and the core follow. With 5 refs., 2 tabs., 58 figs..

18192 **(NIIAR—20(666)) Software for the administrator functions in the factographic information retrieval system.** Rudkevich, A.V. (Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1985. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701518/JAW.

Administrator functions of the factographic information retrieval system have been analysed: data base-management glossary control, user servicing, software development. Dialogue software providing the most important administration operations as applied to the IRMA information system on reactor material testing are described. The IRMA system data base management is realized on the basis of the control system for file library on magnetic carriers. Files are divided into base and additional ones. Each base file is included in one of data bases. 9 refs.

18193 **(NUREG/CR—4662) Closeout of IE Bulletin 80-18: Maintenance of adequate minimum flow thru centrifugal charging pumps following secondary side high energy line rupture: [Technical report, April 21, 1986-July 15, 1987].** Foley, W.J.; Dean, R.S.; Hennick, A. (Parameter, Inc., Elm Grove, WI (USA)). Jan 1988. 33p. (PARAMETER/IE—159). NTIS, PC A03/MF A01 - GPO. Order Number TI88900298/JAW.

On May 8, 1980, Westinghouse reported to the NRC/IE per Title 10 CFR Part 21 that one or more centrifugal charging pumps could be damaged by low flow at certain plants before satisfactory termination of safety injection after a secondary side high energy line rupture. The plants of concern had been notified, a calculational method of evaluation and plant-specific reviews had been recommended, and interim modifications had been proposed by Westinghouse. The NRC/IE issued IE Bulletin 80-18 on July 24, 1980 because of this potential safety-related problem. Licensees and near-term licensees of pressurized water reactors (PWRs) were required to take specific actions and submit written responses. Utilities with PWRs under construction were issued the bulletin for information, in preparation for the licensing process. Evaluation of utility responses and NRC/Region inspection reports shows that the bulletin can be closed out per specific criteria for 44 (96%) of the 46 facilities to which it was issued for action. A followup item for the remaining dual plant is proposed for use by the NRC to ensure satisfactory completion of required and corrective actions.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 18234, 18269, 18270, 18271, 18272, 18275, 18288, 18289, 18290, 18292, 18294, 18623

18194 **(CONF-871101—77) Internally deposited fallout from the Chernobyl reactor accident.** Schlenker, R.A. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003035/JAW.

From Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; Los Angeles, CA, USA (15 Nov 1987).

In our work with about 100 subjects resident in eastern Europe (mostly Poland) at the time of the Chernobyl reactor accident or traveling as tourists, ^{131}I was readily detectable in the thyroid through mid-June, 1986, and was detectable in some subjects as late as early July, 9 to 10 weeks after the start of the accident. Among 42 subjects who were in eastern Europe on April 26, 1986, and in whom ^{131}I was detectable, the median activity in the thyroid was 1.4 nCi at the time of measurement. When extrapolated back to April 26 using a single exponential retention function for the thyroid and an 8-day effective half-life, the median activity was 42 nCi. The frequency distribution resembled a lognormal distribution. The extrapolated activities lay between approximately 2 and 1200 nCi. The risk levels derived from these observations of internal radioactivity and my conservative dose projection assumptions are as much as 10 times less than the risk levels published in the lay press during the months following the accident. This underscores the importance of basing risk estimation for internal radioactivity on direct observations. 2 refs., 1 tab.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

18195 **(BARC—1345) Seismic analysis of 500 MWe pressurised heavy water reactor building under horizontal and vertical ground motion.** Soni, R.S.; Ramireddy, G.; Kushwaha, H.S.; Kakodkar, A.; Karandikar, G.V.; Pain, M.R.; Goray, J.S.; Kulkarni, N.N. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 308p. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88701230/JAW.

This report deals with the investigations carried out for the evaluation of earthquake induced forces and deflections in the 500 MWe PHWR building. The analysis of reactor building has been carried out for two mutually perpendicular horizontal excitations (N-S and E-W) and the vertical excitation. The reactor building has been analysed using beam model taking into account soil-structure interactions. 3-D FEM analysis as well as experimental work has been done to arrive at geometrical properties of various segments of beam model. NPB has developed site dependent ground response spectra for the various sites (e.g. Nagarjunasagar, Tarapur and Kakrapar) in view for 500 MWe stations. After a study of the spectra for various sites, it was considered possible to evolve one envelope ground motion spectrum to cover the seismic motions of various sites in view at present. This was done mainly to avoid repeated design efforts and to have a standard design for the sites in view. Analysis of the reactor building has been carried out in two phases viz. time history analysis and the response spectrum analysis. Time history analysis has been carried out for Kakrapar Atomic Power Project (KAPP) ground motion as well as for compatible time history of enveloping spectrum. Initially preliminary design, analysis was carried out with the KAPP ground motion. Subsequently a check back analysis was carried out with the compatible time history of enveloping spectrum using the same design. Floor response spectras at various levels have been generated for the enveloping motion only. In order to assess the sufficiency of envelope spectrum, as the envelope ground motion was under development stage at that time, limited analysis (response spectrum analysis only), was carried out for the three sites using response spectrum approach for each individual site. This report presents the results of analysis for both the phases.

18196 **(DPST—87-578) Habitat Evaluation Procedure (HEP) assessment for thermal mitigation alternatives for C and K reactors.** Mackey, H.E. Jr.; Davis, C.E.; Price, L.M.; Fay, W.; Ezra, C.E. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.; Davis (Charles E.), Montmorenci, SC (USA); Exploration Software, Athens, GA (USA); EG and G Energy Measurements, Inc., Las Vegas, NV (USA)). Oct 1987. Contract AC09-76SR00001. 325p. NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE88004791/JAW.

The potential effects on wildlife of the implementation of thermal mitigation alternatives for C and K reactors were evaluated using Habitat Evaluation Procedures (HEP) developed by the US Fish and Wildlife Service (FWS) and modified by the Savannah

River Laboratory (SRL) for the Savannah River Plant (SRP) environment. These procedures allow for the relative ranking of project alternatives and/or mitigation with respect to representative wildlife species over the life of the project or for selected time periods in the future. The Department of Energy-Savannah River was requested by the FWS to provide a HEP analysis for the cooling water alternatives for C and K reactors during the comment period on the Draft Thermal Mitigation Environment Impact Statement, Alternative Cooling Water Systems (DOE, 1986). For C and K reactors the potential wildlife impacts and/or benefits of once-through and recirculating cooling towers were evaluated for both near-term (30-year) and long-term (100-year) time periods.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 18171, 18216, 18221, 18229, 18231, 18274, 18282, 18314, 20646

18197 **(CEA-CONF—9100) Seismic analysis of LMFBR core by an homogeneization method.** Brochard, D.; Gantenbein, F.; Gilbert, R.J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Jul 1987. 28p. (CONF-870636—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751860/JAW.

From 5. national congress on pressure vessels and piping; San Diego, CA, USA (28 Jun 1987).

This paper presents a method to take into account the global fluid structure interaction effects in tube bundles (reactor core for example). This method consists of the definition of an equivalent homogeneous medium which replaces the physical medium (tubes and fluid) which is heterogeneous. We will first present the way to derive the equations of this equivalent medium, in the case of small displacements (acoustic behaviour for the fluid), and then the way of implementing this new medium in computer codes. Finally two tests of validation are presented: 1) a validation of the acoustic homogeneous model applied to the geometry of the LMFBR cores; 2) an application to the geometry of the mock-up RAPSODIE.

18198 **(CONF-8706258—2) The thermodynamics of pyrochemical processes for liquid metal reactor fuel cycles.** Johnson, I. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003073/JAW.

From US/Japan seminar on high-temperature chemistry of current light water reactors of advanced all-metal reactors; Tokyo, Japan (6 Jun 1987).

The thermodynamic basis for pyrochemical processes for the recovery and purification of fuel for the liquid metal reactor fuel cycle is described. These processes involve the transport of the uranium and plutonium from one liquid alloy to another through a molten salt. The processes discussed use liquid alloys of cadmium, zinc, and magnesium and molten chloride salts. The oxidation-reduction steps are done either chemically by the use of an auxiliary redox couple or electrochemically by the use of an external electrical supply. The same basic thermodynamics apply to both the salt transport and the electrotransport processes. Large deviations from ideal solution behavior of the actinides and lanthanides in the liquid alloys have a major influence on the solubilities and the performance of both the salt transport and electrotransport processes. Separation of plutonium and uranium from each other and decontamination from the more noble fission product elements can be achieved using both transport processes. The thermodynamic analysis is used to make process design computations for different process conditions.

18199 **(FEI—1820) Detecting the gas bubbles in a liquid metal coolants by mans of magnetic flowmeters.** Mogil'ner, A.I.; Morozov, S.A.; Zakharov, S.O.; Uralets, A.Yu. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 24p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701427/JAW.

Solution of some problems of control and diagnosis of circuits with a liquid-metal coolant (LMC) often requires the detection of gas bubbles penetrating the circulaton loop. The sources of gas intake can be presented by failed fuel elements in reactor core, failed heat-exchange surfaces in sodium-water steam generators in the secondary circuits, gas capture by circulating coolant from gas circuits. Sometimes the gas is especially injected into circulating coolant to study the dynamics of accumulation and extraction of gas bubbles and to solve research problems, related to simulations of emergency situations. The most commonly used methods for gas bubble detection include methods, based on measuring coolant electric conductivity. Method for detecting gas bubbles in LMC, based on revealing the change of its electric conductivity is considered. Magnetic flowmeter is used as a detecting element of these changes. Approximate theory for describing spectral and energy noises in signals of a magnetic flowmeter, controlling the flow rate of LMC with gas bubbles is suggested. New method for signal reading is suggested. Experimental results, illustrating possibility of using the method for measuring the rate of bubble movement and studying the dependence of gas bubble volume on the flow rate of injected gas are presented. 6 refs.; 8 figs.

18200 **(WAPD-TM—1387) Light Water Breeder Reactor fuel rod design and performance characteristics (LWBR Development Program).** Campbell, W.R.; Giovengo, J.F. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Oct 1987. Contract AC11-76PN00014. 175p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88005498/JAW.

Light Water Breeder Reactor (LWBR) fuel rods were designed to provide a reliable fuel system utilizing thorium/uranium-233 mixed-oxide fuel while simultaneously minimizing structural material to enhance fuel breeding. The fuel system was designed to be capable of operating successfully under both load follow and base load conditions. The breeding objective required thin-walled, low hafnium content Zircaloy cladding, tightly spaced fuel rods with a minimum number of support grid levels, and movable fuel rod bundles to supplant control rods. Specific fuel rod design considerations and their effects on performance capability are described. Successful completion of power operations to over 160 percent of design lifetime including over 200 daily load follow cycles has proven the performance capability of the fuel system. 68 refs., 19 figs., 44 tabs.

18201 **(WAPD-TM—1601) Preparation of LWBR [Light Water Breeder Reactor] spent fuel for shipment to ICPP [Idaho Chemical Processing Plant] for long term storage (LWBR Development Program).** Hodges, B.W. (ed.). (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Oct 1987. Contract AC11-76PN00014. 149p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88005565/JAW.

After successfully operating for 29,047 effective full power hours, the Light Water Breeder Reactor (LWBR) core was defueled prior to total decommissioning of the Shippingport facility. All nuclear fuel and much of the reactor internal hardware was removed from the reactor vessel. Non-fuel components were prepared for shipment to disposal sites, and the fuel assemblies were partially disassembled and shipped to the Expended Core Facility (ECF) in Idaho. At ECF, the fuel modules underwent further disassembly to provide fuel rods for nondestructive testing to establish the core's breeding efficiency and to provide core components for examinations to assess their performance characteristics. This report presents a basic description of the processes and equipment used to prepare and to ship all LWBR nuclear fuel to the Idaho Chemical Processing Plant (ICPP) for long-term storage. Preparation processes included the underwater loading of LWBR fuel into storage liners, the sealing, dewatering and drying of the storage liners, and the final pressurization of the storage liners with inert neon gas. Shipping operations included the underwater installation of the fuel loaded storage liner into the Peach Bottom shipping cask, cask removal from the waterpit, cask preparations for shipping, and cask shipment by tractor trailer to the ICPP facility for long-term storage. The ICPP facility preparations for LWBR fuel storage and the ICPP process for discharge of the fuel into underground silos are presented. 10 refs., 42 figs.

18202 (WAPD-TM—1605) End-of-life nondestructive examination of Light Water Breeder Reactor fuel rods (LWBR Development Program). Gorscak, D.A.; Campbell, W.R.; Clayton, J.C. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Oct 1987. Contract AC11-76PN00014. 288p. NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE88005094/JAW.

In-bundle and out-of-bundle (single rod) nondestructive examinations of Light Water Breeder Reactor fuel rods were performed. In-bundle examinations included visual examination and measurement of rod bow, rod-to-rod gaps, and rod removal forces. Out-of-bundle examinations included rod visuals and measurement of fuel rod length, diameter and ovality, cladding oxide and crud thickness, support grid induced cladding wear mark depth and volume, and fuel rod free hanging bow. The out-of-bundle examination also included ultrasonic inspection for cladding defects, neutron radiography for pellet integrity and plenum gap measurements, and gamma scans for instack axial gap screening and binary fuel stack length measurements. The measurements confirmed design predictions of fuel rod performance and provided evidence of excellent fuel rod performance for operation of Light Water Breeder Reactor to 29,047 effective full power hours (EFPH).

18203 (WAPD-TM—1608) Primary disassembly of Light Water Breeder Reactor modules for core evaluation (LWBR Development Program). Greenberger, R.J.; Miller, E.L. (Bettis Atomic Power Lab., West Mifflin, PA (USA)). Oct 1987. Contract AC11-76PN00014. 148p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88005095/JAW.

After successfully operating for 29,047 effective full power hours, the Light Water Breeder Reactor (LWBR) core was defueled prior to total decommissioning of the Shippingport Atomic Power Station. All nuclear fuel and much of the reactor internal hardware was removed from the reactor vessel. Non-fuel components were prepared for shipment to disposal sites, and the fuel assemblies were partially disassembled and shipped to the Expended Core Facility (ECF) in Idaho. At ECF, the fuel modules underwent further disassembly to provide fuel rods for nondestructive testing to establish the core's breeding efficiency and to provide core components for examinations to assess their performance characteristics. This report presents a basic description of the processes and equipment used to disassemble LWBR fuel modules for subsequent proof-of-breeding (POB) and core examination operations. Included are discussions of module handling fixtures and equipment, the underwater milling machine and bandsaw assemblies, and the associated design and operation of this equipment for LWBR fuel module disassembly.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 18302, 18369

18204 (INIS-XN—86) Royal Decree-Law 1302/1986 of 28 June 1986 on environmental impact studies. (International Atomic Energy Agency, Vienna (Austria)). 30 Jun 1986. 3p. (In Spanish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701321/JAW.

Published in Boletin Oficiel del Estado No 155.

This Royal Decree-Law (No 1302/1986) of 28th June 1986 was published in the Official Gazette of 30th June 1986. The purpose of this Decree-Law is to provide for assessments of the environmental impact of certain projected installations and activities. The installations and activities requiring environmental impact studies are listed in the Annex to the Decree-Law and include nuclear power plants and other nuclear reactors (excluding those whose thermal power does not exceed 1 kW) as well as installations for the disposal and final storage of radioactive waste (NEA).

18205 (NUREG—0750-Vol.25-No.6) Nuclear Regulatory Commission issuances, June 1987. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Jun 1987. 131p. NTIS, PC A07/MF A01 - GPO. Order Number TI88900301/JAW.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decision (DD), and the Denials of Petitions for Rulemaking (DPRM).

18206 (NUREG—0750-Vol.26-No.1) Nuclear Regulatory Commission issuances, July 1987. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Jul 1987. 76p. NTIS, PC A05/MF A01 - GPO. Order Number TI83900363/JAW.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

18207 (NUREG—0750-Vol.26-No.2) Nuclear Regulatory Commission issuances, August 1987. (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Publications Services). Aug 1987. 42p. NTIS, PC A03/MF A01 - GPO. Order Number TI88900332/JAW.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

2108 Economics

REFER ALSO TO CITATION(S) 18164, 18190, 18191, 18202, 18203

18208 (INIS-BR—939) Risks in the operation of hydroelectric power plants and nuclear power in Brazil. Goldemberg, J. (Sao Paulo Univ. (Brazil)). 1986. 14p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701475/JAW.

A comparison between the utilization of electrical energy generated by hydroelectric power plant and nuclear power plant is made. The risks from nuclear installations and the environmental effects of hydroelectric power plants and nuclear power plants are presented. (E.G.).

18209 (ORNL/TM—10563) Cost estimating relationships for nuclear power plant operationa and maintenance. Bowers, H.I.; Fuller, L.C.; Myers, M.L. (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006050/JAW.

Revised cost estimating relationships for 1987 are presented for estimating annual nonfuel operation and maintenance (O and M) costs for light-water reactor (LWR) nuclear power plants, which update guidelines published previously in 1982. The purpose of these cost estimating relationships is for use in long range planning and evaluations of the economics of nuclear energy for electric power generation. A listing of a computer program, LWROM, implementing the cost estimating relationships and written in advanced BASIC for IBM personal computers, is included.

18210 Goals and requirements for advanced reactor concepts. Harvego, E.A.; Lussie, W.G. (Idaho National Engineering Lab., P.O. Box 1625, Idaho Falls, ID 83415). pp 1524-1529 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—). Contract AC07-76ID01570.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879207.

Economic problems and public concerns about safety have lead to a reassessment of current nuclear power plant designs and the development of improved designs or new reactor concepts to better meet the needs of United States utilities. This paper presents

a set of goals and requirements, developed by the Idaho National Engineering Laboratory (INEL), to provide a means for evaluating the relative merits of alternate advanced reactor concepts. This set of requirements and goals is intended to be independent of any particular reactor concept, and is predicated on the assumption that nuclear power cannot become viable option until the public is favorable to the use of nuclear power for electric power generation in the United States. Under this assumption, the top level requirements defined for new reactor concepts are (1) public acceptability, (2) acceptable investment risk, (3) competitive life cycle costs, and (4) early deployment. Each of these requirements is supported by several related lower level requirements and design goals that are necessary or desirable to meet the top level requirements.

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 18243, 19930

18211 (BARC—1367) COMESH - A corner mesh finite difference code to solve multigroup diffusion equations in multidimensions. Jagannathan, V.; Kulkarni, A.K.; Jain, R.P. (Bhabha Atomic Research Centre, Bombay (India)). 1987. 42p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701248/JAW.

A code called COMESH based on corner mesh finite difference scheme has been developed to solve multigroup diffusion theory equations. One can solve 1-D, 2-D or 3-D problems in Cartesian geometry and 1-D (r) or 2-D (r-z) problem in cylindrical geometry. On external boundary one can use either homogeneous Dirichlet (θ-specified) or Neumann (nablaθ specified) type boundary conditions or a linear combination of the two. Internal boundaries for control absorber simulations are also tackled by COMESH. Many an acceleration schemes like successive line overrelaxation, two parameter Chebyschev acceleration for fission source, generalised coarse mesh rebalancing etc., render the code COMESH a very fast one for estimating eigenvalue and flux/power profiles in any type of reactor core configuration. 6 refs.

18212 (ENEA-RT-TIB—86-49) Example of utilization of Kalman filters in time series analysis. Marseguerra, M.; Porceddu, C.M. (ENEA, Rome (Italy)). 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701283/JAW.

In reactor noise analysis the fluctuation of many interesting signals may be described by linear models such as the AR, ARMA or ARMAX ones. Another interesting approach of increasing importance is the Kalman filter methodology. In the this paper a linear system described by an autoregressive AR(2) model is considered and it is investigated whether the Kalman filter is capable of correctly estimating parameters together with their accuracies both in the stationary state and in the case of sudden variation of the parameters. In addition a more complex situation in which a stationary system under investigation feeds the sensor which delivers the observed signal. Assuming the system obeying on AR(2) model and the sensor a simpler AR(1) model, the problem is that of recovering the system output from the measured signal.

18213 (FEI—1724) Combined calculation of linear functionals in a shield with inhomogeneities. Aleshechkin, V.N.; Polevoj, V.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 17p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703157/JAW.

A method for solving problems of radiation transport in a nuclear reactor shield with three-dimensional inhomogeneities based on sequential application of kinetic programs is described. The shielding composition is divided into a series of separate zones, where radiation transport is calculated sequentially, transfer from one zone to another being realized by flux transportation on the boundaries. The method is realized on the basis of ROZ-6 and SMK-10 programs based on the S/sub N/ and Monte Carlo methods. An example of calculating thermal neutron flux in the control system is given. 9 references, 5 figures, 2 tables.

18214 (IAE—4261/4) Calculating the parameters of reactor kinetics with increased accuracy. Mysenkov, A.I.; Shastin, K.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703199/JAW.

The procedure of reactor-kinetics-equation solution with high accuracy and the program realizing this procedure are described. The method is based on approximation of reactor neutron flux density and concentration of nuclei precursors of delayed neutrons on the final time interval by the polynomial of the 3d type. This approach permits by-passing multiple limitations of different numerical methods applied before to solve the same problem (restriction in value of a time step due to possibility of stability loss, in condition of completeness of a set of point kinetics equations, in value of the induced error on every time step). Calculations of reactor kinetics for different variants of reactivity representation are carried out. 2 references, 2 figures, 6 tables.

18215 (KURRI-TR—294) Proceedings of the 2nd KURRI [Kyoto University Research Reactor Institute] symposium on criticality safety. Nishina, Kojiro; Kanda, Keiji (eds.). (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.; Nagoya Univ. (Japan)). 7 Apr 1987. 114p. (In Japanese and English). (CONF-8702126—). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88900375/JAW.

From 2. KURRI symposium on criticality safety; Kyoto, Japan (2 Feb 1987).

This volume contains the proceedings of the Nuclear Criticality Safety Seminar. The proceedings are addressed to individuals engaged in criticality safety practice, regulation, and research. Papers contained in the volume cover neutron transport calculations, fuel distribution in reactor cores, the criticality safety handbook of Japan, nuclear material transport safety, and experimental results. (JDH)

18216 (LA—11206-MS) PERTV: A standard file version of the PERT-V code. George, D.C.; LaBauve, R.J. (Los Alamos National Lab., NM (USA)). Feb 1988. Contract W-7405-ENG-36. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005663/JAW.

The PERT-V code, used in two-dimensional perturbation theory, fast reactor analysis, has been modified to accept input data from standard files ISOTXS, GEODST, ZNATDN, NDXSRF, DLAYXS, RTFLUX, and ATFLUX. This modification has greatly reduced the additional input that must be supplied by the user. The new version of PERT-V, PERTV, has all the options of the original code including a plotting capability. 10 refs., 3 figs., 12 tabs.

18217 (PNL—6476) COBRA-IV PC: A personal computer version of COBRA-IV-I for thermal-hydraulic analysis of rod bundle nuclear fuel elements and cores. Webb, B.J. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1988. Contract AC06-76RL01830. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88006245/JAW.

COBRA-IV PC is a modified version of COBRA-IV-I, adapted for use with most IBM PC and PC-compatible desktop computers. Like COBRA-IV-I, COBRA-IV PC uses the subchannel analysis approach to determine the enthalpy and flow distribution in rod bundles for both steady-state and transient conditions. The steady-state and transient solution schemes used in COBRA-IIIC are still available in COBRA-IV PC as the implicit solution scheme option. An explicit solution scheme is also available, allowing the calculation of severe transients involving flow reversals, recirculations, expulsions, and reentry flows, with a pressure or flow boundary condition specified. In addition, several modifications have been incorporated into COBRA-IV PC to allow the code to run on the PC. These include a reduction in the array dimensions, the removal of the dump and restart options, and the inclusion of several code modifications by Oregon State University, most notably, a critical heat flux correlation for boiling water reactor fuel and a new solution scheme for cross-flow distribution calculations. 7 refs., 8 figs., 1 tab.

18218 **Implementation of stratified sampling for Monte Carlo applications.** Brown, R.S. Jr.; Hendricks, J.S. (Univ. of Arizona, Tucson). *Transactions of the American Nuclear Society;* **54**: 156-157(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

Stratified sampling is used in Monte Carlo calculations to take advantage of certain known aspects of probability distributions. The sampling region is subdivided into discrete subregions, each of which is sampled a preassigned number of times. Stratified sampling, also known as quota sampling, has been known for decades, but its implementation into major production Monte Carlo computer codes has been limited. It was used in the SAM code and in the French TRIPOLI code. The authors recently implemented and tested stratified sampling for the distance-to-collision estimate in the Monte Carlo MCNP code. Not only is this a significant enhancement of a major Monte Carlo computer code, but also the authors believe they are presenting the first published empirical measurement of the stratified sampling effect.

18219 **Effect of mass rebalancing on COMMIX-1B iterative solution schemes.** King, J.B.; Anghaie, S.; Domanus, H.M. (Oregon State Univ., Corvallis). *Transactions of the American Nuclear Society;* **54**: 178-179(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

COMMIX-1B is a single-phase, three-dimensional, thermal-hydraulics code that can be used to analyze both steady-state and transient problems. The code utilizes both the conjugate gradient (CG) and successive overrelaxation (SOR) methods to solve the system of three-dimensional discrete pressure field equations. The method of mass rebalancing is used to accelerate the convergence of these iterative solution schemes. In this method, fluid cells in the computational domain are grouped into a few regions that are called rebalancing regions. Next, pressures of all newly formed computational cells are corrected by a constant amount in such a way that the conservation of mass is presented. After providing such a large-scale and computationally inexpensive corrective to pressure field equations, the fine pressure adjustment is to be done by using either CG or SOR techniques. This paper discusses the effect of mass rebalancing on the convergence of these iterative solution schemes.

18220 **Microcomputer-based reactor physics at INEL - a status report.** Parsons, D.K.; Nigg, D.W. (Idaho National Engineering Lab., Idaho Falls). *Transactions of the American Nuclear Society;* **54**: 52-53(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

Work is progressing at the Idaho National Engineering Lab. (INEL) on a comprehensive system of microcomputer-based codes for reactor physics and shielding analysis. Two separate but parallel efforts are ongoing. The first involves a system of code modules for use in an IBM-PC-class environment. This is primarily oriented toward the university community as well as toward interested utilities, consultants, etc. The second effort involves development of a very similar code system for use with the much more powerful 32-bit workstation computer systems now becoming widely available. Use of this more sophisticated hardware extends the applicability of the microcomputer-based code system to detailed design analysis in addition to the scoping analyses and teaching applications that would be more typical of a personal computer-based environment. This summary reviews progress made to date on the INEL microcomputer-based reactor physics code system and indicates some future directions for the effort.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 18133, 18286, 18291, 18301, 18578, 18891, 20631, 20664, 20725, 20726, 20729

18221 **(CEA-CONF—9099) French administrative practice and design codes for nuclear vessels.** Roche, R.L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Jul 1987. 21p. (CONF-870636—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751859/JAW.

From 5. national congress on pressure vessels and piping; San Diego, CA, USA (28 Jun 1987).

French regulations on boilers and pressure vessels have prevailed for a very long time, the first measure having been promulgated on 29 October 1823. Restraining the attention to nuclear pressure vessels it must be pointed out regulations and enforcement by public authorities are more stringent than they are for conventional pressure vessels. The first part of this paper will be devoted to regulations with a special attention to the decree of 26 February 1974 and to the practice of public authorities in this field with special attention given to the Bureau de Controle de la Construction Nucleaire (BCCN = Bureau of Inspection of Nuclear Design and Manufacturing). The second part of this paper will deal with the French construction codes for nuclear components RCC-M (water reactors) and RCC-MR (elevated temperature design).

18222 **(ENEA-RT-TIB—86-1) Rapid thermal transient in a reactor coolant channel.** Cherubini, A. (ENEA, Rome (Italy)). 1986. 55p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88701278/JAW.

This report deals with the problem of one-dimensional thermo-fluid-dynamics in a reactor coolant channel, with the aim of determining the evolution in time of the coolant (H*L2O), in one- and/or two-phase regimes, subjected to a great and rapid increase in heat flux (accident conditions). To this aim, the following are set out: a) the physical model used; b) the equations inherent in the above model; c) the numerical methods employed to solve them by means of a computer programme called CABO (CAnale BOllente). Next a typical problem of rapid thermal transient resolved by CABO is reported. The results obtained, expressed in form of graphs, are fully discussed. Finally comments on possible developments of CABO follow.

18223 **(FEI—1674) Calculation of coolant flow in a nuclear reactor pressure collector.** Kumaev, V.Ya.; Leonchuk, M.P.; Shvetsov, Yu.E.; Dvortsova, L.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 21p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703148/JAW.

Effect of output lattice resistance and a relative height of the collector on peculiarities of liquid flow and distribution of coolant flow rate in a distribution collector of a reactor was investigated. Numerical integration of two-dimensional equations of coolant flow in a model of the distribution collector and in the inlet annular channel ignoring azimuthal perturbations at the inlet was carried out. The calculations showed that, when increasing the relative height of the collector, the vortex was formed at the inlet of the collector due to the sudden flow rotation at the outlet from the inlet annular channel. The inlet vortex causes decrease of the flow rate at the collector periphery down to inverse stream formation. Application of displacers at the bottom of the collector leads to decreasing flow rate in the center and to levelling flow rate nonuniformity over the whole collector. Perturbation of only radial flow at the inlet leads to formation of vortices with the vertical axis near the center of the collector and to decrease of the rate at the outlet near the vortex region. 7 references, 15 figures.

18224 **(IA—1427, pp 28-30) Iodine removed by condensation from containment atmosphere in post external event conditions.** Ketter, A.; Wacholder, E.; Elias, E. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18225 (NUREG/CR—4810) Evaluation of diesel unavailability and risk effective surveillance test intervals. Vesely, W.E.; DeMoss, G.M.; Lofgren, E.V.; Ginzburg, T.; Samanta, P.; Boccio, J. (Brookhaven National Lab., Upton, NY (USA); Nuclear Regulatory Commission, Washington, DC (USA). Div. of Risk Analysis and Operations). May 1987. Contract AC02-76CH00016. 80p. (BNL-NUREG—52022). NTIS, PC A05/MF A01 - GPO. Order Number TI87013328/JAW.

In this report risk and reliability approaches are presented which allow risk acceptable test intervals to be determined for any diesel. Data required to apply the approaches are also described. The approaches can be applied not only to diesels, but to any component with suitable data. Incorporation of the approaches in personal computer (PC) software is discussed, which can provide tools for the regulator or plant personnel for any plant specific or generic application. The FRANTIC III computer code was run to validate the approaches and to evaluate specific issues associated with determining risk-effective test intervals for diesels. Using the approaches presented, diesel accident unavailability can be more effectively monitored and controlled on a plant-specific or generic basis. Test intervals can be made more risk effective than they are now, producing more acceptable accident unavailabilities, and avoiding the possible deleterious effects of Regulatory Guide 1.108. The methods presented are one step toward performance-based technical specifications, which more directly control risks.

18226 (NUREG/CR—5063) Development of a mechanistic understanding of radiation embrittlement in reactor pressure vessel steels: Final report. Ebrahimi, F.; Hoelzer, D.T.; Venables, D.; Krishnamoorthy, V. (Florida Univ., Gainesville (USA). Dept. of Materials Science and Engineering). Jan 1988. 89p. (MEA—2268). NTIS, PC A05/MF A01 - GPO. Order Number TI88900296/JAW.

The microstructures of a series of reactor pressure vessel (RPV) steels and model iron alloys with various Cu, Ni, and P contents were examined in unirradiated and neutron-irradiated conditions using high resolution analytical microscopy. Fractography techniques were also applied. Objectives were to isolate and identify the mechanisms by which these elements affect steel radiation embrittlement sensitivity as evidenced by notch ductility and tensile strength changes. Radiation hardening of a reference iron alloy was found associated with the formation of prismatic dislocation loops of an interstitial nature. A very low density of loops was observed for a low Cu-low P steel having a low radiation sensitivity. Copper decreased the size and increased number density of observable defects; however, the enhancement of radiation sensitivity by Cu is due to a radiation-induced formation of Cu-rich clusters/precipitates. No synergism between Cu and Ni was found in the model iron alloys except for an enrichment of the Cu clusters with Ni. Alloys containing appreciable P did not show intergranular fracture. The detrimental effect of this impurity on radiation sensitivity for the case of a low Cu content is due to a radiation-induced clustering of P. Phosphorus clustering was found absent in a high Cu-high P iron alloy, consistent with the apparent inactive role of P in radiation sensitivity of high Cu steels. The effect of alloying/impurity elements on the evolution of defect structures during irradiation is ascribed to vacancy trapping by solute atoms, leading to an increased number density of defects.

18227 (PNL-SA—15374) Heat pipe transient analysis: Vapor dynamics. Kelly, J.M.; Schor, A.L. (Pacific Northwest Lab., Richland, WA (USA); Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). Jan 1988. Contract AC06-76RL01830. 48p. (CONF-880122—6). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005132/JAW.

From 5. symposium on space nuclear power systems; Albuquerque, NM, USA (11 Jan 1988).

A multidimensional model for the analysis of heat pipe transients (HPTRAN) is being developed. The cornerstone of this model is a new "partially implicit" numerical algorithm for two phase flow. Time steps far in excess of the Courant limit (CFL number of 100 to 200) are allowed, without the computational burden per time step that accompanies a fully implicit treatment. The resulting computational efficiency renders transient multidimensional analysis practicable. This paper provides a brief description of the numerical method and presents the results of initial data comparisons. Bowman (1987) performed a series of experiments to investigate heat pipe vapor dynamics using a porous tube with blowing/suction. These tests were simulated using both distributed (2-D) and lumped (1-D) parameter models. Stable solutions were obtained using large time steps for a wide range of Reynolds (5×10^4-10^6) and Mach (0.1 to 1.0) numbers. Good data comparisons were achieved, with the multidimensional model outperforming the one-dimensional model. Areas for future improvements were identified in both the turbulence model and the finite difference form of the momentum flux terms.

2203 Fuel Elements

REFER ALSO TO CITATION(S) 18187, 18252, 18906

18228 (CONF-8710111—29) Improved eddy-current inspection for steam generator tubing. Dodd, C.V.; Deeds, W.E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 17p. NTIS, PC A03. Order Number DE88001769/JAW.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

The Oak Ridge National Laboratory is working on a number of steam generator and eddy-current problems, and one of the most promising developments is the use of reflection type probes. This probe consists of a driver coil encircling and coaxial with two pick-up coils, which are connected in opposition. The reflection probe is mounted perpendicular to the tube axis with one pick-up coil pressed against the surface like a pancake coil. Studies were performed to determine the best probe dimensions to maximize the ratio of defect signals to the undesired od property variations at different frequencies. Comparisons between reflection probes and the traditional circumferential or bobbin probes show that the former are more sensitive to defects and less sensitive to variation of properties outside the tube, such as tube supports, magnetite, and copper. The probe can be used in either multiple frequency or pulsed instruments in a manner similar to the bobbin probes. Since the undesired property variations have a smaller effect on the signal, they are easier to eliminate using multiple frequency or pulsed techniques. This has been demonstrated by test runs on standard steam generator tubes with different types of defects and different property variations. The reflection probe has given measurements of actual IGSCC cracks that compare well to the metallographic results. This type of probe has very good resolution and gives fine and accurate scans of the tubing, but is more expensive, complex, and slower. 10 figs., 2 tabs.

18229 (FEI—1713) Interchannel thermal interaction in peripheral region of fast-reactor fuel assemblies. Zhukov, A.V.; Matyukhin, N.M.; Rymkevich, K.S.; Sorokin, A.P.; Bogoslovskaya, G.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 19p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703154/JAW.

The results of experimental and calculational investigation of temperature fields in the periphery region of the fast reactor fuel assembly were presented. Experiments are carried out with the dummy fuel assembly of the BN-600 reactor. Assembly consists of 37 fuel elements arranged in the trigonal lattice with 1.85 relative step and enclosed in hexahedral can. A relative gap between the can and the periphery fuel elements is 0.5. Element spacing is carried out by one-directed wire coilings. One of the dummy elements (side or corner) was heated in steady-state conditions; and coolant temperature at the outlet of the assembly is measured. Experiments are carried out in the range of the Peclet's number $50 \leqq Pe \leqq 300$. The data obtained permit to detect the effect of intensive directed heat exchange in near-the-wall gap between the can and fuel elements. Calculations of temperature fields of the assembly show good agreement with the experimental data. 11 references, 13 figures, 1 table.

18230 (FEI—1729) Calculating characteristics of thermal reliability of reactor cores during lifetime. Leonchuk, M.P.; Khranovskij, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703158/JAW.

History and technique for calculating thermotechnical reliability characteristics of reactor cores are considered. The calculation of random temperature deviations is based on the concept of individual consideration of global and local factors causing the deviations. Relations for evaluating probabilities of temperature failure for an arbitrary number of fuel elements are given. Method for determining area of fuel element surface subjected to the given temperature range is suggested. Using the given relations it is possible to solve the problems of temperature (energy releases) profile optimization during the core lifetime for providing at any moment the required reliability level of a projected core. 40 references, 1 table.

18231 (FEI—1778) Thermal-physical substantiation of temperature conditions for fast-reactor fuel assemblies taking into account overheating factors and tamperature fields. Zhukov, A.V.; Sorokin, A.P.; Ushakov, P.A.; Matyukhin, N.M.; Tikhomirov, B.B.; Titov, P.A.; Mantlik, F.; Shul'ts, V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 44p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703165/JAW.

Results of the analysis of experimentally obtained temperature distributions over a fuel element perimeter in a central and near the wall zones of fast-reactor hexagonal fuel assemblies (FA) are presented. Ways to generalize the experimental and calculational materials are shown, and particular generalizing dependences for the maximum nonuniformities of temperature in deformed fuel-element lattices for wide ranges of geometric parameter variations (deformation directions, FA with and without displacer, smooth and ribbed fuel elements, various gaps between FA shroud and fuel elements) are obtained. The method for calculating temperature distribution over the fuel-element perimeter in deformed lattices is presented. The method is tested using experimental material. Results of the calculational analysis of temperature fields in fast reactor FA point to a considerable effect of FA shape change on the temperature fields in fuel elements and FA shroud. The methods of overheating-factor calculation is specified due to considering the effects of interchannel exchange on coolant overheating. An approach to the calculation of thermal technical reliability of FA is described. 26 references, 20 figures.

18232 (IAE—4133/4) Experimental study of pressure in sealed fuel elements with uranium dioxide fuel. Fadin, S.Yu.; Murashov, V.N.; Yakovlev, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703172/JAW.

Pressure history inside fuel element-cladding was experimentally investigated during life tests at the MR reactor in constant and dynamic modes. N-1 alloy clad UO_2 fuel was irradiated. Length of the fuel column was to 1003 mm. Fuel elements were filled with He at pressure of up to 0.1 MPa and tested for tightness. Pressure inside fuel cladding irradiated for 17000 h to 22 MWxday/kg(U) burnup increased from 0.2 to 3.0 MPa in hot fuel elements and from 0.1 to 1.1 MPa in cold ones. Pressure history can be conditionally separated into four periods: three-step increase of filling gases pressure with corresponding increases of reactor power during first hours of operation; incubation period (zone of stable pressure) at burnup from 0.5 to 1.0 MWxday/kg(U) conditioned with times of formation and saturation of intergranular pores; period of intense pressure growth at burnup from 3 to 8 MWxday/kg(U); decay of pressure growth at burnup above 8 MWxday/kg(U). It is concluded that gas pressure growth has a step profile with abrupt pressure increase during each start-up after reactor shut-down. 36 references, 6 figures.

18233 (IAE—4176/3) Optimization of reactor fueling regime after pre-term withdrawal of failed fuel assembly. Ajrapetyan, A.A.; Shevelev, Ya.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703180/JAW.

A simple reactor model with a heat release field fully leveled in the radial direction and linear reactivity dercease with power generation growth is considered. Thus, the reactor refueling patterns are considered to differ slightly from the patterns, where all assemblies are in the reactor for n_0 intervals between refuelings. For such a model the next factor is shown. If a part of fuel is recharged in the stationary condition in n intervals differing from n_0, it is not economically profitable, except that case when $n_0 > \sqrt{2n}$/ sub opt/ (n/sub opt/ is the optimal number of rechargings during a fuel cycle). Small deviations of a part of charged fuel channels from $1/n_0$ at linear approximation have no affect on the efficiency. If a failured fuel assembly is recharged ahead of shedule, then the assemblies operating less than n_0 intervals should not be withdrawn in the recharged conditions after accident. The damage caused by the fact that an assembly operated by i intervals less is approximately proportional to $(i/n_0)^2$. This denendence is accurate within the limit $n_0 \to \infty$. 5 references.

18234 (IAE—4190/4) Calculational and theoretical studies of nuclear-reactor fuel-element reliability. Kolomytkin, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 39p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703186/JAW.

Papers devoted to calculational and theoretical studies of the stress-strain state of fuel assemblies in different conditions are reviewed to determine the possibilities of application of the methods existing for estimation of reliability of WWER and RBMK reactor fuel assemblies. It is shown that the classical methods for mechanics of the deformed solid do not allow the effect of numerical factors accompanying real-operation conditions to be accounted for. Thus, a special attention should be paid to systematic accumulation of experimental data on physical and mechanical properties of fuel-assembly materials in conditions approaching experimental ones. 151 references.

18235 Method of bonding. Saller, H.A.; Hodge, E.S.; Paprocki, S.J.; Dayton, R.W. (to Dept. of Energy, Washington, DC). US Patent 4,709,848. 1 Dec 1987. Filed date 2 Oct 1957. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

A method of making a fuel-containing structure for nuclear reactors is described comprising providing an assembly comprising fuel units consisting of a core plate containing thermal-neutron-fissionable material, sheets of cladding metal on its bottom and top surfaces, the cladding sheets being of greater width and length than the core plates whereby recesses are formed at the ends and sides of the core plate, and end pieces and first side pieces of cladding metal of the same thickness as the core plate positioned in the recesses. The assembly further comprises second side pieces of cladding metal engaging the cladding sheets so as to space the fuel units from one another, and filler plates of an acid-dissolvable nonresilient material whose melting point is above 2000°F, arranged between a pair of the second side pieces and the cladding plates of two adjacent fuel units. The filler plates have the same thickness as the second side pieces. The method further comprises enclosing the entire assembly in an envelope; evacuating the interior of the entire assembly through the envelope; applying inert gas under a pressure of about 10,000 psi to the outside of the envelope while at the same time heating the assembly to a temperature above the flow point of the cladding metal but below the melting point of any material of the assembly, slowly cooling the assembly to room temperature; removing the envelope; and dissolving the filler plates without attacking the cladding metal.

2204 Control Systems

REFER ALSO TO CITATION(S) 18175, 18276, 18313

18236 (EPRI-NP—5598) Computer-assisted design of a PWR [pressurized-water reactor] digital control system: Final report. Shah, S.C.; Chen, D.P. (Integrated Systems, Inc., Santa Clara, CA (USA)). Jan 1988. 109p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920154/JAW.

Modern control design methods and Computer-Aided-Control-Design tools can provide improved control system performance in power plants. Conventional PID controller designs rely on simplistic models of the process to be controlled. This requires a fair amount of ad-hoc on-line tuning for good performance. Modern controller designs based on validated nonlinear simulation models can provide higher performance control and yet require fewer design iterations than PID designs. Low power steam generator level control displays the so-called shrink-swell phenomenon. This non-minimum phase response is difficult to model and control using classical PID tuning methods. A library of nuclear power plant component models is created using MATRIX/sub x/, a Computer-Aided-Control Design tool. Particular emphasis is placed on the low power steam generator level response. The modern controller performance is evaluated against a one element PID controller for low power level control. The modern controller is a digital hierarchical controller with a lower level feedwater flow controller. Global linearization of feedwater valve, a full state estimator, and a state feedback level controller results in superior control over a wider range of parameter variations. Nonlinear simulations show an improvement of four to six fold in the speed of response over a PID controller tuned with classical methods for the non-minimum phase response of the the steam generator level.

18237 (FEI—1710) On-line control system. Software and hardware. Boldisov, V.I.; Dubrovskij, O.A.; Kupriyanov, V.M.; Makarova, I.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703153/JAW.

The reactor monitoring complex (RMC) has been operated in FEhI since 1980. Its organization, hardware, and software are oriented so as to solve practical problems of the development of monitoring algorithms for nuclear power plants. The complex is based on the ES-1010 minicomputer with developed technical means for data storage and representation, for communication with objects of investigation, for dialogue. The basic equipment of the complex is supplied by the VIDEOTON firm (Hungary). Interactive disk-operating system extended for the complex hardware is the basic operating system of the complex. To automate the studies, special software (SS) is developed. SS comprises a number of subsystems, ensuring input of analogue data, output of graphic data, mathematical processing of experimental and technological data, and communication with other computers. All the subsystems operate in a dialogue mode. Hardware and software of the complex, the main principles and possibilities of SS are described. 14 references, 1 figure.

18238 (FEI—1714) Correlation method for measuring absolute power of zero-power reactors. Part 2. Technical realization of the method. Mogil'ner, A.I.; Aleshchenkov, V.B.; Zakharov, S.O.; Morozov, S.A.; Martynov, E.B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 17p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703155/JAW.

Principles of designing devices for measuring absolute power of reactors by the correlation method are considered. A model of the analog-to-digital device, realizing the correlation method for measuring absolute power of zero-power reactors and ways of its gauging using harmonic and noise signals are described. The results of device testing at the critical facility are given. The correlation method is shown to be applicable for efficiency of the neutron detectors of 2.3×10^{-5} order, when the frequency method is not applicable. The conclusion is made that the data obtained agree well with the results of measurements carried out by the frequency method. 6 references, 5 figures.

18239 (FEI—1771) Multi-detector digital reactivity meter on the base of MERA-60-15 microcomputer. Bakov, A.T.; Kanunnikov, Yu.S.; Kulabukhov, Yu.S. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701425/JAW.

Suitably developd devices and programs implemented a multi-detector (four detectos) reactivity meter on the base of MERA-60-15 microcomputer are described. Software developed allows for measuring and calculating the reactivity using every channel of the reactivity meter both in the online and off-line modes with one and the same variant of the experimental data. The program for reactivity calculation implies two main branches: reactivity calculation on the basis of kinetics point equation solution and reactivity determination taking into account spatial effects at the approximation of linear dependence of the detector efficiency on time. Besides, the program allows for calculating and introducing corrections for a reactivity power effect, as well as correcting the counting rate for the known dead time when using pulse detectors. The program and its different modifications have been tested at the BN-600, BN-350 at Kola NPP and BR-10 reactors and the BFS critical assembly. Its application decreases the proper systematic error in comparison with the program for reactivity calculation based on the kinetics point model. Application of the multi-detector reactivity meter allows not only to save time due to avoiding repeat measurements by different detectors, but gives the possibility to fix maximally fast faults occurring in measurement paths by comparing directly the results obtained simultaneously in different channels. 5 refs.; 2 figs.

18240 (FRADOC—10-3) Plant maneuvrability in France: recent developments and future prospects. Gautier, A.; Guesdon, B. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Jun 1986. 9p. (CONF-860603—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751876/JAW.

From 4. European nuclear conference and 9. FORATOM congress (ENC '86) and international nuclear trade fair; Geneva, Switzerland (1 Jun 1986).

In the early 1970's, it was correctly anticipated that in 10 year's time PWR's would become major contributors to energy production in France and would therefore have to participate largely in adjustment of supply to demand. A substantial effort was launched between vendor (FRAMATOME), utility (EDF) and the French Atomic Energy Commission (CEA) to greatly improve PWR's flexibility, resulting in the current situation where both frequency control and load follow are now routinely performed on most plants in operation. Based on rapidly accumulating operational experience and on all expertise acquired in the past decade, a second-generation core control strategy is now being finalized for application on all future 1400 MW plants (with commercial operation scheduled in 1992 for first unit). This core control includes a maximized Reactor Advanced Maneuvrability Package (RAMP or Dispositif maximise de Manoeuvrabilite Accrue DMAX in French) and an automated system control boron concentration (SYCOBOR).

18241 (FRCEA-TH—29) Pressurized water reactor monitoring. Study of detection, diagnostic and estimation (least squares and filtering) methods. Gillet, M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France); Aix-Marseille-2 Univ., 13 - Marseille (France)). Jul 1986. 152p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE87753208/JAW.

This thesis presents a study for the surveillance of the Primary circuit water inventory of a pressurized water reactor. A reference model is developed for the development of an automatic system ensuring detection and real-time diagnostic. The methods to our application are statistical tests and adapted a pattern recognition method. The estimation of the detected anomalies is treated by the least square fit method, and by filtering. A new projected opti-

mization method with superlinear convergence is developed in this framework, and a segmented linearization of the model is introduced, in view of a multiple filtering. 46 refs.

18242 (NUREG/CP—0089) Proceedings of the CSNI specialist meeting on training of nuclear reactor personnel. (Nuclear Energy Agency, 75 - Paris (France). Committee on the Safety of Nuclear Installations). Dec 1987. 495p. (CONF-8704249—; CSNI—138). NTIS, PC A21/MF A01 - GPO. Order Number TI88900305/JAW.

From CSNI specialists meeting on training of nuclear reactor personnel; Orlando, FL, USA (21 Apr 1987).

Separate abstracts were prepared for the individual papers in this report. (JDB)

18243 Solution of generalized control system equations at steady state. Vilim, R.B. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **54**: 171-172(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

Although a number of reactor systems codes feature generalized control system models, none of the models offer a steady-state solution finder. Indeed, if a transient is to begin from steady-state conditions, the user must provide estimates for the control system initial conditions and run a null transient until the plant converges to steady state. Several such transients may have to be run before values for control system demand signals are found that produce the desired plant steady state. The intent of this paper is (a) to present the control system equations assumed in the SASSYS reactor systems code and to identify the appropriate set of initial conditions, (b) to describe the generalized block diagram approach used to represent these equations, and (c) to describe a solution method and algorithm for computing these initial conditions from the block diagram. The algorithm has been installed in the SASSYS code for use with the code's generalized control system model. The solution finder greatly enhances the effectiveness of the code and the efficiency of the user in running it.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 17807, 18196, 18282, 18285, 18295, 18296, 18297, 20637

18244 (EPRI-NP—5526-Vol.1) Radwaste generation survey update: Volume 1, Boiling water reactors: Final report. Daloisio, G.S.; Deltete, C.P. (Analytical Resources, Inc., Sinking Springs, PA (USA)). Feb 1988. 455p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920182/JAW.

The Electric Power Research Institute (EPRI) commissioned an operations-related project (RP1557-26) in mid-1986 to update the project data base developed for EPRI Report NP-3370, "Identification of Radwaste Sources and Reduction Techniques," which was published in January 1984. An update was deemed particularly desirable in order to assess the impact on power reactor low level radioactive waste generation of 10 CFR 61, the recent implementation of the 1985 Amendment to The Low Level Waste Policy Act of 1980 (and its potential effects on accelerated waste shipment programs), and the efforts of several plants to implement waste minimization programs over the past several years. These events, as reflected in waste generation rates from 1982 through 1986, should help NP-3370 continue to be a useful document for a plant's radwaste manager in the future. Furthermore, the trends of the past several years presented herein should help to more accurately define utility waste source terms for use in planning on-site storage and developing regional burial facilities. A new data base was developed that includes 1982 through 1986 information, as well as pertinent portions of the 1978 through 1981 data base. The result of the project is a two volume report comprising radwaste related information from more than 95% of the nuclear power plants in commercial operation as of 1986. Volume 1 contains all information pertaining to boiling water reactors (BWRs), while Volume 2 contains information for pressurized water reactors (PWRs). The computerized data base of waste volumes, sources and characteristics for each plant type (BWR or PWR) is included as an appendix in each respective volume.

18245 (EPRI-NP—5526-Vol.2) Radwaste generation survey update: Volume 2, Pressurized water reactors: Final report. Daloisio, G.S.; Deltete, C.P. (Analytical Resources, Inc., Sinking Springs, PA (USA)). Feb 1988. 698p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920183/JAW.

The Electric Power Research Institute (EPRI) commissioned an operations-related project (RP1557-26) in mid-1986 to update the project data base developed for EPRI Report NP-3370, "Identification of Radwaste Sources and Reduction Techniques," which was published in January 1984. An update was deemed particularly desirable in order to assess the impact on power reactor low level radioactive waste generation of 10 CFR 61, the recent implementation of the 1985 Amendment to the Low Level Waste Policy Act of 1980 (and its potential effects on accelerated waste shipment programs), and the efforts of several plants to implement waste minimization program over the past several years. These events, as reflected in waste generation rates from 1982 through 1985, should help NP-3370 continue to be a useful document for a plant's radwaste manager in the future. Furthermore, the trends of the past several years presented herein should help to more accurately define utility waste source terms for use in planning on-site storage and developing regional burial facilities. A new data base was developed that includes 1982 through 1986 information, as well as pertinent portions of the 1978 through 1981 data base. The result of the project is a two volume report comprising radwaste related information from more than 95% of the nuclear power plants in commerical operation as of 1986. Volume 1 contains all information pertaining to boiling water reactors (BWRs), while Volume 2 contains information for pressurized water reactors (PWRs). The computerized data base of waste volumes, sources and characteristics for each plant type (BWR or PWR) is included as an appendix in each respective volume. 36 figs., 26 tabs.

18246 (IA—1427, pp 36-37) Guidelines for preparation of environmental impact assessment of industrial zones. Amir, S. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18247 (IAE—4286/3) Nuclear power engineering, safety, and environment. Kulikov, E.V.; Legasov, V.A.; Ryazantsev, E.P.; Sidorenko, V.A.; Belyaev, A.I.; Demin, V.F.; Kryshev, I.I.; Kuz'min, I.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 30p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703204/JAW.

Role of nuclear power engineering (NPE) in the country fuel-energy balance, its structure and development trends are considered. A short characteristic of current and prospective nuclear power reactors is given. A system of ensuring power plant safety and other NPE facilities is described. It includes state and industry control organizations, a system of specifications, technical, and other safety measures. Data characterizing safety level for NPP personnel and population are presented. NPE and coal energy complexes are compared with respect to environmental impact. 37 references, 11 figures, 7 table.

18248 (BARC—1347) Earthquakes from peninsular India: data from the Gauribidanur seismic array. Gangrade, B.K.; Prasad, A.G.V.; Sharma, R.D. (Bhabha Atomic Research Centre, Bombay (India)). 1987. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701232/JAW.

Arrival times of the P and S wave signals recorded at the Gauribidanur seismic array from earthquakes in the neighbouring areas in peninsular India have been analysed to estimate their locations (latitudes and longitudes of the epicenters), magnitudes and origin times. Considering typical inaccuracies in the observed data, uncertainties in the estimated epicentral parameters have been illustrated. Using a crustal model, which has been specifically derived for the region around the array, expected arrival times of these signals at other important seismic stations (Kodaikanal, Hyderabad, Poona, New Delhi and Shillong) have been computed for identify-

ing events at these stations in order to determine accurate arrival times at these stations. Due to a higher signal detection capability of the Gauribidanur array, the number of events given in this catalogue is much greater than that detected by these stations. The M/ sub S/ magnitude estimates of events detected at the Hyderabad station have been used to obtain a magnitude scale for Gauribidanur. Origin times, epicentral locations and magnitudes of these events are listed in this report. 10 refs., 3 figures, 3 tables.

18249 **(BARC—1350) Research and development activities of the Seismology Section for the period January 1984 - December 1985.** Krishnan, C.A.; Murty, G.S. (eds.). (Bhabha Atomic Research Centre, Bombay (India)). 1987. 83p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88701235/JAW.

The Research and Development (R and D) activities during 1984-1985 of the Seismology Section of the Bhabha Atomic Research Centre, Bombay are reported in the form of individual summaries. The R and D activities of the Section are directed towards development of seismological instruments and methods of analysis of the seismic field data with the main objective of detecting underground nuclear explosions and assessing seismicity and seismic risk of sites considered for nuclear power stations. The Section has two field stations - one at Gauribidanur in the Southern part of the country and another at Delhi i.e. in the northern part of the country. During the report period, a total of 62 events out of the detected ones were identified as underground explosions. The expertise of the Section is also made available for outside organisations. (M.G.B.).

18250 **(BARC—1365) Spectral shapes for accelerograms recorded at soil sites.** Ghosh, A.K.; Sharma, R.D. (Bhabha Atomic Research Centre, Bombay (India)). 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701247/JAW.

Earthquake accelerograms recorded on soil sites have been analysed to develop site-specific response spectra. This report presents the normalised pseudo-absolute acceleration spectra for various values of damping and ground motion parameters viz. v/a, ad/ v/sup 2/ and the ratios of peak accelerations in the three orthogonal directions. These results will be useful in the earthquake resistant design of structures. 4 tables, 14 figures.

18251 **(NUREG/CR—5080) A study of New England seismicity with emphasis on Massachusetts and New Hampshire: Final report covering the period 1976-1985.** Toksoz, M.N.; Kadinsky-Cade, K. (Massachusetts Inst. of Tech., Cambridge (USA). Earth Resources Lab.). Jan 1988. 133p. NTIS, PC A07/MF A01 - GPO. Order Number TI88900336/JAW.

Network daily activities progressed from determining phase arrival times on analog records from a handful of field stations to operation of an efficient real-time data acquisition system with advanced seismic data analysis capabilities. Quarterly progress reports have provided continuous reporting of seismic activity in our area for monitoring purposes. Phase data from the MIT network have regularly been included in the Northeastern US Seismic Network (NEUSSN) bulletins. This report summarizes daily operations and describes some of the scientific results obtained from data provided by this and surrounding regional seismic networks. The scientific results can be divided into several categories or topics: velocity structure models, earthquake hazard studies, and the determination of earthquake mechanisms and focal depths, crustal stresses and seismic wave attenuation. Key components in our ability to complete these studies have been the reasonably close station spacing (about 50 km) in the northeastern US and the continuous operation of the networks over a period of several years.

18252 **(CONF-8706258—3) Mass spectrometry studies of fission product behavior: 1, Fission products released from irradiated LWR [light-water reactor] fuel.** Johnson, I.; Johnson, C.E. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003072/JAW.

From US/Japan seminar on high-temperature chemistry of current light water reactors of advanced all-metal reactors; Tokyo, Japan (6 Jun 1987).

The chemical form and rate of release of volatile fission products (i.e., Xe, Kr, Cs, Te, I...) effused from an irradiated LWR fuel pin sample were studied using quadrupole mass spectrometry. Experiments, up to a temperature of 2120 K, 2060 K have identified krypton, xenon, cesium, and tellurium as the species released from the fuel. In addition, there was a weak signal for atomic iodine at 1325 K. The source of the atomic iodine, e.g. dissociation of cesium iodine or dissociation of molecular iodine, has yet to be resolved. The observed rate of release of xenon was several orders of magnitude lower than previously reported. However, the xenon release rate increased significantly after the fuel was oxidized. In complementary experiments on nonradioactive material, the release of tellurium was hindered by reaction with Zircaloy cladding. Above 1300°C, gaseous SnTe was observed; its formation is attributed to reaction of the tin (in the cladding) with $ZrTe_2$. 4 refs., 5 figs.

18253 **(NUREG/CR—2850-Vol.6) Population dose commitments due to radioactive releases from nuclear power plant sites in 1984.** Baker, D.A. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1988. Contract AC06-76RL01830. 147p. (PNL—4221-Vol.6). NTIS, PC A07/MF A01 - GPO. Order Number TI88005201/JAW.

Population radiation dose commitments have been estimated from reported radionuclide releases from commercial power reactors operating during 1984. Fifty-year dose commitments from a one-year exposure were calculated from both liquid and atmospheric releases for four population groups (infant, child, teen-ager and adult) residing between 2 and 80 km from each of 56 sites. This report tabulates the results of these calculations, showing the dose commitments for both liquid and airborne pathways for each age group and organ. Also included for each of the sites is a histogram showing the fraction of the total population within 2 to 80 km around each site receiving various average dose commitments from the airborne pathways. The total dose commitments (from both liquid and airborne pathways) for each site ranged from a high of 110 person-rem to a low of 0.002 person-rem for the sites with plants operating throughout the year with an arithmetic mean of 5 person-rem. The total population dose for all sites was estimated at 280 person-rem for the 100 million people considered at risk. The site average individual dose commitment from all pathways ranged from a low of 6×10^{-6} mrem to a high of 0.04 mrem. No attempt was made in this study to determine the maximum dose commitment received by any one individual from the radionuclides released at any of the sites.

18254 **(NUREG/CR—2907-Vol.6) Radioactive materials released from nuclear power plants: Annual report, 1985.** Tichler, J.; Norden, K.; Congemi, J. (Brookhaven National Lab., Upton, NY (USA)). Jan 1988. Contract AC02-76CH00016. 285p. (BNL-NUREG—51581-Vol.6). NTIS, PC A13/MF A01 - GPO. Order Number TI88005660/ JAW.

Releases of radioactive materials in airborne and liquid effluents from commercial light water reactors during 1985 have been compiled and reported. Data on solid waste shipments as well as selected operating information have been included. This report supplements earlier annual reports issued by the former Atomic Energy Commission and the Nuclear Regulatory Commission. The 1985 release data are summarized in tabular form. Data covering specific radionuclides are summarized.

18255 **(CIEMAT—604) Earth microcosms. A technique to evaluate the effect produced by pollutants.** Sanchez Cabrero, B.; Sanchez Gimeno, B.; Varela, J. (Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid (Spain)). 1987. 61p. (In Spanish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88701259/ JAW.

Chemical pollution is one of the risks of industrialization. Daily there emerge a great deal of chemical compounds and it is necessary to assess the risk they might suppose to the environmental and/or human health. Till recently, the toxicity tests of the chemicals or their transformation products, were carried out using individuals of a few species. This approach doesn't seem correct because it ignores the relations that are established at the ecosystem

level. Microcosms pretend to be an adecuated tool for the ecotoxicologicals tests. This review presents two different parts: in the first one, we show the possible applications of microcosms, in the second one, we present the validation and evaluation of the soil core microcosms, following the works done by EPRI and EPA. It would be interesting to assess and validate the soil core microcosms using it with fumigation of atmospheric pollutant in controlled environment and subsequently compare the results obtained in the laboratory with those obtained in the field. We think that this approach, along with other techniques, may be useful. (author). 6 figs., 37 refs.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 18238, 18265, 18619

18256 (ANL/RERTR/TM—10) Performance of low-enriched U_3Si_2-aluminum dispersion fuel elements in the Oak Ridge Research Reactor. Copeland, G.L.; Hobbs, R.W.; Hofman, G.L.; Snelgrove, J.L. (Oak Ridge National Lab., TN (USA); Argonne National Lab., IL (USA)). Oct 1987. Contract W-31109-ENG-38. 130p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88004143/JAW.

Six high-density, low-enriched U_3Si_2-Al dispersion fuel elements have been tested in the Oak Ridge Research Reactor (ORR). The elements were geometrically identical to standard ORR elements. The uranium density in the fuel meat ranged between 4.6 and 5.2 Mg/m^3. The elements were fabricated by B & W, CERCA, and NUKEM using their normal materials and fabrication practices, with minor modifications necessitated by the new fuel. The U_3Si_2 contained minor amounts of USi, U_3Si and/or uranium solid solution. The elements were irradiated to approximately normal ORR burnup, and three elements were irradiated twice as long, to average burnups of ~80% of the initially contained ^{235}U, well above the burnups normally achieved in research and test reactors. Peak burnups of 98% were achieved. Following suitable cooling periods, the elements were subjected to a series of nondestructive and destructive examinations. The behavior of the fuel was found to be entirely consistent with the known irradiation behavior of the constituent phases. The extremely stable swelling behavior of the U_3Si_2 phase dominated in all cases. The plates showed small, uniform thickness changes. Blister threshold temperatures were ≧550°C. It is concluded that low-enriched U_3Si_2-Al dispersion fuel elements will perform at least as well in research and test reactors with power densities up to that of the ORR as the highly enriched UAl/sub x/-Al and U_3O_8-Al dispersion fuels currently being used. There were no indications that use of this fuel under substantially more stringent conditions might be precluded. 10 refs., 87 figs., 9 tabs.

18257 (BARC—1342) Computed neutron spectra and dose distribution in the ion-chamber basket of Dhruva reactor. Sundaram, V.K.; Nagarajan, P.S.; Somasundaram, S. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 68p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88701227/JAW.

The neutron spectra in the ion-chamber (IC) basket of Dhruva reactor have been computed, adopting a hybrid approach, using ANISN code to study the transport of neutrons up to the region of interest and employing MORSE code to track them in the more complicated geometry region of the IC basket. ICRU based fluence-to-dose conversion factors are used to obtain the neutron dose distribution. A neutron dose of 500 rads per 100 Mwd of reactor operation is obtained in the paraffin used in the IC basket. Assuming a limiting dose of 10/sup 8/ rads for 25 per cent radiation damage in paraffin and the contribution of gamma radiation to the total dose to be twice that of neutrons, the irradiation period for paraffin to attain the limiting dose is estimated to be about 180 years. Further work is in progress to obtain the gamma dose distribution. 5 refs., 9 tables, 10 figures.

18258 (IAE—4162/4) Peculiarities of the IRT-2000 reactor reconstruction at IYaIYaEh NRB. Goncharov, V.V.; Arkhangel'skij, N.V.; Buslaev, V.S.; Egorenkov, P.M.; Emel'yanov, M.K.; Karpukhin, A.A.; Peskov, A.O.; Taliev, A.V.; Yudin, I.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 17p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703175/JAW.

Structural features and experimental possibilities of the IRT-5000 reactor (reconstructed IRT-2000 reactor), in which fuel assemblies of the IRT-2M type with uranium of 36% concentration being used instead of fuel assemblies with EhK-10 elements, are considered. Technical and physical data on the IRT-5000 reactor are given. Reconstruction of the reactor provides: possibility of reactor operation with the 60-83 l core volume at — 7.5 MW, i.e. 4 times higher to reconstruction. Neutron-flux densities in in-core channels are increased up to $1.5x10^{14}$ n/m^2xs, in the beryllium reflector up to $(1\text{-}1.5)x10^{14}$ n/cm^2xs, in the water reflector up to $0.5x10^{14}$ n/cm^2xs. The fast neutron flux density ($E > 0.821$ MeV) in the core increased up to $(0.6\text{-}1.0)x10^{14}$ n/cm^2xs. The substantial expansion of reactor experimental possibilities due to the increase of the quantity of experimental channels is reached. 7 references, 5 figures.

18259 (IAE—4264/4) Substantiation of the Maria reactor cell selection for studies on problems of safety and thermal reliability of WWER reactor cores. Egorenkov, P.M.; Zvonov, N.V.; Kuznetsov, Eh.M.; Nasonov, V.A.; Sal'nikov, N.L.; Tsipulin, V.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703201/JAW.

The results of experiments and calculations carried out to substantiate the selection of the Maria reactor cell for investigations on problems of safety and thermal reliability of WWER reactor cores are presented. The investigations were carried out with a simulator of a loop fuel assembly made up with fuel elements of the WWER type with 4.4%, 6.5%, and 9.9% ^{235}U content by means of a critical facility with the physical model of MR reactor, which loading simulates Maria reactor core loading. On the basis of the experiments and calculations, the possibility of reaching 540 W/cm thermal load on the fuel elements with 6.5% and 9.9% ^{235}U content is shown. 7 references, 10 figures.

18260 (ORNL/TM—10603) Modeling heat generation and flow in the Advanced Neutron Source Corrosion Test Loop specimen. Pawel, R.E.; Yarbrough, D.W. (Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 20p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006039/JAW.

A finite difference computer code HEATING5 was used to model heat generation and flow in a typical experiment envisioned for the Advanced Neutron Source Corrosion Test Loop. The electrical resistivity and thermal conductivity of the test specimen were allowed to vary with local temperature, and the corrosion layer thickness was assigned along the length of the specimen in the manner predicted by the Griess Correlation. The computer solved the two-dimensional transport problem for a given total power dissipated in the specimen and stipulated coolant temperatures and water-side heat-transfer coefficients. The computed specimen temperatures were compared with those calculated on the basis of approximate analytical equations involving the total power dissipation and the assignment of the physical properties based on temperatures at single axial points on the specimen. The comparisons indicate that when temperature variations are large along the axis of the specimen, the variation in local heat flux should not be overlooked when using approximate equations or models. The approximate equations are most accurate near the center of the specimen where the heat flux remains closest to the average value, and in that region the calculated quantities agree closely with the results of the computer code. 4 figs., 1 tab.

18261 **(WHC-SA—0015) Smart sensor application to nuclear plant thermocouple channels.** Cannon, N.S.; Martin, J.D.; Patterson, B.A.; Stringer, J.L.; Zimmerman, B.D.; Heinisch, H.L.; Cannon, C.P. (Westinghouse Hanford Co., Richland, WA (USA); Pacific Northwest Lab., Richland, WA (USA); Cannon Technology, Kennewick, WA (USA)). 1987. Contract AC06-87RL10930. 12p. (CONF-870832—10). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004470/JAW.

From Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry; Snowbird, UT, USA (31 Aug 1987).

The application of smart sensor technology to thermocouple (TC) channels at the Fast Flux Test Facility (FFTF) has been accomplished. The objective of this work was to provide a first step toward the development of nuclear plant sensor systems that not only produce a transducer output signal, but also perform diagnostics on the sensor channel to provide signal validation. When TC impairment was detected, the system provided an analysis of the severity of the damage, its location, and probable cause. Two systems were constructed: a laboratory system for development purposes, and a follow-on system for installation at FFTF. Since its installation, the FFTF system continues to provide TC trending data for lifetime predictions, and a test facility for new concepts. The laboratory system has been adapted to include a new sensor type, an FFTF low-level neutron flux monitor.

2207 Plutonium And Isotope Production Reactors

REFER ALSO TO CITATION(S) 18260, 18278, 18281, 18310, 18619

18262 **Neutron reaction rate measurements in an organically moderated lattice of FTR fuel pins.** Bierman, S.R.; Fukumura, N. (Pacific Northwest Lab., Richland, WA). *Transactions of the American Nuclear Society;* **54**: 198-200(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

Critical experiments are being conducted in the Battelle Pacific Northwest Lab.'s Critical Mass Lab. for the Consolidated Fuel Reprocessing Program using a variety of fast test reactor (FTR) fuel pin configurations and fissile solution concentrations. These experiments are being performed as part of a joint agreement between the US Dept. of Energy and the Power Reactor and Nuclear Fuel Development Corp. of Japan on criticality data development. On selected experimental assemblies in this program, absolute neutron reaction rates are being measured to provide basic neutron physics data for use in evaluating nuclear cross sections and calculational methods. The results obtained from the initial set of measurements in this program are presented in this paper. The initial series of reaction rate measurements were made in an experimental critical assembly of FTR fuel pins immersed in a tributylphosphate-normal paraffin hydrocarbon mixture.

18263 **Analytical study of criticality experiments of organic and light-water-moderated mixed-oxide fuel pin arrays.** Aihara, N.; Fukumura, N.; Kadotani, H.; Koyama, T.; Haire, M.J. (PNC, Oarai, Japan). *Transactions of the American Nuclear Society;* **54**: 200-201(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

As part of a joint criticality data development program between the Power Reactor and Nuclear Fuel Development Corp. of Japan and the US Dept. of Energy, critical experiments have been conducted with organically moderated fast test reactor (FTR) mixed-oxide fuel pin arrays. The neutronic characteristics of an organic moderator can be examined by comparing the results of these experiments with the results of the same type of experiments performed with light-water-moderated systems. In recent experiments performed at the Battelle Pacific Northwest Laboratory's Critical Mass Laboratory, five distances of the lattice pitches were utilized that span from soft to hard neutron energy spectra. These lattice pitches range from a volume ratio of 1.62 to 18.13. The organic solution consisted of ~ 32 vol % tributyl phosphate (TBP) and 68 vol % normal paraffin hydrocarbon (NPH). Results obtained by benchmark analyses of these experiments are discussed in this paper.

2208 Propulsion Reactors

18264 **(EGG-M—38287) A comparison of propulsion systems for potential space mission applications.** Harvego, E.A.; Sulmeisters, T.K. (EG and G Idaho, Inc., Idaho Falls (USA); Martin Marietta Corp., Englewood, CO (USA)). 1987. Contract AC07-76ID01570. 6p. (CONF-871234—12). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005637/JAW.

From ASME winter meeting; Boston, MA, USA (13 Dec 1987).

A derivative of the NERVA nuclear rocket engine was compared with a chemical propulsion system and a nuclear electric propulsion system to assess the relative capabilities of the different propulsion system options for three potential space missions. The missions considered were (1) orbital transfer from low earth orbit (LEO) to geosynchronous earth orbit (GEO), (2) LEO to a lunar base, and (3) LEO to Mars. The results of this comparison indicate that the direct-thrust NERVA-derivative nuclear rocket engine has the best performance characteristics for the missions considered. The combined high thrust and high specific impulse achievable with a direct-thrust nuclear stage permits short operating times (transfer times) comparable to chemical propulsion systems, but with considerably less required propellant. While nuclear-electric propulsion systems are more fuel efficient than either direct-nuclear or chemical propulsion, they are not stand-alone systems, since their relatively low thrust levels require the use of high-thrust ferry or lander stages in high gravity applications such as surface-to-orbit propulsion. The extremely long transfer times and inefficient trajectories associated with electric propulsion systems were also found to be a significant drawback.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 17844, 18194, 18247, 18375, 18724, 20646

18265 **(ANL—87-29) Analysis of proposed gamma-ray detection system for the monitoring of core water inventory in a pressurized water reactor.** Markoff, D.M. (Argonne National Lab., IL (USA)). Dec 1987. Contract W-31109-ENG-38. 212p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88005785/JAW.

An initial study has been performed of the feasibility of employing an axial array of gamma detectors located outside the pressure vessel to monitor the coolant in a PWR. A one-dimensional transport analysis model is developed for the LOFT research reactor and for a mock-PWR geometry. The gamma detector response to coolant voiding in the core and downcomer has been determined for both geometries. The effects of various conditions (for example, time after shutdown, materials in the transport path, and the relative void fraction in different water regions) on the detector response are studied. The calculational results have been validated by a favorable comparison with LOFT experimental data. Within the limitations and approximations considered in the analysis, the results indicate that the gamma-ray detection scheme is able to unambiguously respond to changes in the coolant inventory within any vessel water region.

18266 **(CEA-CONF—9144) Organizations putting in place in case of accident in a French nuclear power plant.** Noc, B.; Queniart, D. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Jan 1987. 9p. (In French). (CEA-DAS—316; CONF-8611215—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751864/JAW.

From Seminar concerning safety studies on severe accident in light water reactors; Brussels, Belgium (10 Nov 1986).

In case of accident entraining radiological consequences on or near the site of nuclear power reactor, organizations are putting in place. These organizations include as well as side of operating authority (generally Electricite de France) or public organizations

including safety organizations (Service Central de Surete des Installations Nucleaires, Institut de Protection et de Surete Nucleaire), one local organization and one centralized national organization. Informations exchange and coordination necessary between these organizations are governed by protocols. These protocols include particularly, the problems of mobilizing experts and of dealing with the saturation of normal telecommunications channels. The lessons acquired during accident simulation exercises carried out in recent years are progressively put in place in these protocols.

18267 (CEA-CONF—9149) Few outstanding points in French nuclear safety. Queniart, D. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Mar 1987. 37p. (In French and English). (CEA-DAS—359; CONF-8703234—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751866/JAW.

From Seminar on reactor technics and safety in France; Mainz, F.R. Germany (10 Mar 1987).

This document constitutes a philosophic presentation of French safety and the approach which results for technical analysis of PWRs safety.

18268 (CEA-CONF—9155) Propagation of fire in a PWR. Consequences for safety. Deletre, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Apr 1987. 45p. (In French). (CEA-DAS—355; CONF-8704256—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751867/JAW.

From SFEN meeting on fire prevention in nuclear plants; Paris, France (22 Apr 1987).

This report shows how the utilization of computer code VESTA (fire code of BERTIN Society) in the study of a fire sector have an interest for the optimization of protection fire in a PWR reactor.

18269 (CEA-CONF—9156) Accident of Chernobylsk: interventions and consequences on the nuclear power plant and on the environment. Faure, J.; Duclos, P; Fache, P.; Rzepka, J.P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). 1987. 29p. (In French). (CEA-DAS—363; CONF-8705252—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751868/JAW.

From SFEN meeting on Chernobyl accident: safety and environmental aspects; Paris, France (6 May 1987).

In this report, the author analyses the interventions of Sovietic Authorities and show what the crisis management have made to limit, in large proportions, the consequences of the accident.

18270 (CEA-CONF—9157) Accident of Chernobylsk: chronology and causes. Bregeon, L. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). May 1987. 34p. (In French). (CEA-DAS—366; CONF-8705252—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751869/JAW.

From SFEN meeting on Chernobyl accident: safety and environmental aspects; Paris, France (6 May 1987).

After a brief description of the reactor, the author describes the scenario of the accident of Chernobylsk-4.

18271 (CEA-CONF—9158) Accident of Chernobylsk: emission and dispersion of radioactive products. L'Homme, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). May 1987. 24p. (In French). (CEA-DAS—368; CONF-8705252—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751870/JAW.

From SFEN meeting on Chernobyl accident: safety and environmental aspects; Paris, France (6 May 1987).

This paper describes the difficulties of evaluation of source term because the difficulties in evaluating the transport terms (wind speed and direction) during a long period of time. In spite of these difficulties, the MICAR Code of the Institut de Protection et de Surete Nucleaire (IPSN), based on radioactive fallout in Europe, has given a good evaluation, in agreement with Sovietic Authorities.

18272 (CEA-IPSN-INFO—66) Incidents on the 12th January 1987 at the A power plant of Saint Laurent des Eaux. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). Mar 1987. 2p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753183/JAW.

Published in summary form only.

18273 (CEA-IPSN-INFO—67) Incidents involved by freezing during winter 1986-1987. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). Mar 1987. 2p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753182/JAW.

Published in summary form only.

18274 (CEA-IPSN-INFO—69) Super Phenix Reactor: Escape of sodium in the fuel storage drum. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). Jun 1987. 3p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751871/JAW.

Published in summary form only.

18275 (CEA-IPSN-INFO—71) Escape of UF6 on the site of Tricastin. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire). Jun 1987. 4p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751872/JAW.

18276 (CONF-870832—8) An expert system for sensor data validation and malfunction detection. Hashemi, S.; Hajek, B.K.; Miller, D.W. (Ohio State Univ., Columbus (USA)). 1987. Contract AC02-86NE37965. 7p. NTIS, PC A02. Order Number DE88004920/JAW.

From Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry; Snowbird, UT, USA (31 Aug 1987).

Nuclear power plant operation and monitoring in general is a complex task which requires a large number of sensors, alarms and displays. At any instant in time, the operator is required to make a judgment about the state of the plant and to react accordingly. During abnormal situations, operators are further burdened with time constraints. The possibility of an undetected faulty instrumentation line, adds to the complexity of operators' reasoning tasks. Failure of human operators to cope with the conceptual complexity of abnormal situations often leads to more serious malfunctions and further damages to plant (TMI-2 as an example). During these abnormalities, operators rely on the information provided by the plant sensors and associated alarms. Their usefulness however, is quickly diminished by their large number and the extremely difficult task of interpreting and comprehending the information provided by them. The need for an aid to assist the operator in interpreting the available data and diagnosis of problems is obvious. Recent work at the Ohio State University Laboratory of Artificial Intelligence Research (LAIR) and the nuclear engineering program has concentrated on the problem of diagnostic expert systems performance and their applicability to the nuclear power plant domain. There has also been concern about the diagnostic expert systems performance when using potentially invalid sensor data. Because of this research, an expert system has been developed that can perform diagnostic problem solving despite the existence of some conflicting data in the domain. This work has resulted in enhancement of a programming tool, that allows domain experts to create a diagnostic system that will be to some degree, tolerant of bad data while performing diagnosis. This expert system is described here.

18277 (CONF-870832—9) The structure of an expert system to diagnose and supply a corrective procedure for nuclear power plant malfunctions. Hajek, B.K.; Stasenko, J.E.; Hashemi, S.; Bhatnagar, R.; Punch, W.F. III; Yamada, N. (Ohio State Univ., Columbus (USA); Hitachi Ltd., Ibaraki (Japan). Energy Research Lab.). 1987. Contract AC02-86NE37965. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004919/JAW.

From Topical meeting on artificial intelligence and other innovative computer applications in the nuclear industry; Snowbird, UT, USA (31 Aug 1987).

During the past two years, two prototype knowledge based systems have been developed at the Ohio State University. These systems were the result of collaboration between the Nuclear Engineering Program and the Laboratory for Artificial Intelligence Research (LAIR). The first system uses hierarchical classification to diagnose malfunctions of the coolant system in a General Electric Boiling Water Reactor (BWR). The second system provides a plan of action, through a process of dynamic procedure management, to stabilize the plant once an abnormal transient has occurred. The objective of this paper is to discuss the structure that has been designed to integrate the two systems. The combined system will be capable of informing plant personnel about the nature of malfunctions, and of supplying to the operator the most direct corrective procedure available. Two important features of the integrated system are faulty sensor detection, based on malfunction context and unlike sensor data, and procedure management based on the initial state of the plant. Since the two knowledge based systems were developed separately, the integration has required a separate component currently under development, the Plant Status Monitoring System (PSMS). The task of PSMS is to monitor plant parameters in order to detect an abnormal condition developing within the plant. Based on the nature of the event, PSMS is capable of directing control to either the procedure management or diagnosis component. The integrated system plays only an advisory role, and any suggested action would be executed by the plant personnel.

18278 (DP-MS—87-125) Update: Root cause analysis. Paradies, M.; Busch, D. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 9p. (CONF-8711130—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003320/JAW.

From 4. annual NSAC and operational reactor safety engineering and review group workshop; San Francisco, CA, USA (5 Nov 1987).

This paper describes root cause analysis techniques and the benefits of standardization of root cause analysis. (JDB)

18279 (EGG-M—39787) Issues regarding transient analysis. Duffey, R.B. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 10p. (CONF-8711152—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005641/JAW.

From 5. international RETRAN meeting; Boston, MA, USA (9 Nov 1987).

This paper discusses the evolution and reevolution in transient analysis that has been and is occurring. From strictly design basis transients and the determination of margins and setpoints, emphasis continues to shift to risk-dominant sequences and the importance of equipment reliability and operator actions. The importance of simulation in training, procedure development and accident management follows from these developments. The increase is computer power per dollar places the issue of how best to utilize large mainframe codes in sharper focus.

18280 (EGG-TMI—7825) PORV discharge flow during the TMI-2 accident. Nomura, Y. (EG and G Idaho, Inc., Idaho Falls (USA)). Jul 1987. Contract AC07-76ID01570. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005538/JAW.

PORV discharge flow during the TMI-2 accident was estimated by calculating the void fraction in the pressurizer based on experimental correlations (or zero void fraction when temperature and pressure measurements indicated subcooling) and critical flow through the PORV. A computer program was developed and its validity was demonstrated by comparing calculational and experimental data. Input variables, such as discharge coefficients or effluent fluid enthalpies, were carefully evaluated to assure best calculational results. A case using Wilson's correlation for the saturated pressurizer and linear interpolation in fluid enthalpy between subcooled points as indicated by measurements is considered to give the best-estimate of the total discharge from the PORV during the accident. 13 refs., 34 figs., 5 tabs.

18281 (ENEA-RT-TIB—87-2) Design computations and safety report of a cell for in pile irradiation tests. Verri, A. (ENEA, Rome (Italy)). 1987. 185p. (In Italian). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88701284/JAW.

The criteria adopted in positioning the irradiation cell within the 1Mw TRIGA reactor of the ENEA Casaccia are reported. Maximum heat which can be released by the cell is then evaluated. The final configuration of the cell as a whole, the heating system for the sample under irradiation, the procedure used in the calculations, are also reported. The selection and the design of the safety system, including auxiliary equipments are discussed.

18282 (EPRI-NP—5494) Decommissioning US reactors: Current status and developing issues: Final report. Schwartztrauber, K.E. (Pentek, Inc., Sacramento, CA (USA)). Jan 1988. 149p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920153/JAW.

This report describes the decommissioning status of reactors in the US. The reactors are statistically presented based upon the following criteria: (1) reactors that are involved in active decommissioning operations; (2) reactors that are shutdown and pending operational recovery or decommissioning alternative; and (3) reactors currently operating and their projected shutdown and decommissioning schedules. Precedent setting decommissioning projects are presented to illustrate the technlogical experiences and issues being addressed by the industry. The following decommissioning issues were derived from literature reviews and utility surveys and are considered indicative of the major concerns of the utilities and other industry organizations: How is decommissioning going to be defined in NRC's final rulemaking? What new guidelines, requirements and regulations will ultimately be adopted? How will decommissioning wastes be classified, quantified and where will they be buried? What constitutes de-minimus waste quantities for decommissioning and how will residual radioactivity limits be set for a decommissioned site? What other federal and state entities will set policy affecting decommissioning? Will the uncertainty over decommissioning cost and financial management subside?

18283 (EPRI-NP—5596) Elastic-plastic fracture analysis of through-wall and surface flaws in cylinders: Final report. Kumar, V.; German, M.D. (General Electric Co., Schenectady, NY (USA). Corporate Research and Development Center). Jan 1988. 90p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920185/JAW.

This report addresses the problems of through-wall flaws and surface flaws in cylinders subjected to pure tension, pure bending or combined tension and bending loads. Using nonlinear finite element methods, elastic and fully plastic solutions for the J-integral and certain other fraction parameters have been developed for a broad range of values for cylinder dimensions, flaw size and material properties. Through-wall flaws are analyzed using a shell finite element method, whereas a shell finite element method combined with line-spring model has been employed for the analysis of surface flaws. Elastic-plastic estimation formulae are presented, and the results are compared with elastic-plastic finite element calculations that have been carried out for some representative cases as a part of this project. Results presented herein can be readily used with the J-resistance curve approach to predict crack initiation, stable growth and instability in flawed pressure vessels and piping systems. A leak-before-break fracture mechanics analysis of through-wall flaws in pipes can also be performed using the crack opening displacement solutions developed in this report. 41 refs., 28 figs., 15 tabs.

18284 (EPRI-NP—5597) Aerosol deposition in BWR [boiling-water reactor] steam separators and dryers: Final report. Gieseke, J.A.; Jordan, H. (Battelle Columbus Labs., OH (USA)). Jan 1988. 85p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920157/JAW.

A section of a BWR steam dryer and a steam separator were tested for aerosol particle retention under simulated severe accident conditions. The measured retention efficiencies of the dryer, under isothermal conditions were higher than would be calculated utilizing current models. For a heated carrier gas, the retention efficiencies increased significantly. The retention in the separator could be described reasonably well based on a model of swirling flow. 14 refs., 22 figs., 19 tabs.

18285 (EPRI-NP—5602) Evaluation of aerosol correlations: Final report. Vaughan, E.U.; von Arx, A.V. (Rockwell International Corp., Canoga Park, CA (USA). Rocketdyne Div.). Jan 1988. 80p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920163/JAW.

The evaluation in EPRI NP-4974 of the aerosol correlation method developed by Fauske and Associates, Inc., for the IDCOR program and implemented in the MAAP-3.0 code is extended. Comments on the application of the method to multispecies aerosols and an examination of the internal consistency of the correlations used are followed by comparison with selected aerosol experiments. Both steady-state and decay-mode correlations are tested against observed aerosol concentration histories and measured aerosol particle size distributions. This limited comparison program suffices to indicate some imperfections in the method, whose performance is, nevertheless, commonly satisfactory and may be expected to improve with experience and further refinement. Continued evaluation, development, and exploitation of the method are recommended. 22 refs., 31 figs., 3 tabs.

18286 (EPRI-NP—5617-Vol.1) Recommended piping seismic-adequacy criteria based on performance during and after earthquakes: Volume 1, Summary document: Final report. Silver, M.M.; Hardy, G.S.; Smith, P.D.; Yanev, P.I.; Harris, S.P. (EQE, Inc., San Francisco, CA (USA)). Jan 1988. 72p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920180/JAW.

The objective of this study is to develop seismic adequacy criteria for the visual identification of any features of aboveground welded steel safety-related piping systems in nuclear plants which could cause loss of function in an earthquake with a free-field ground surface acceleration of up to 0.5g. The criteria were developed by (1) collecting and assessing detailed data on the performance of piping at selected power and industrial facilities during past earthquakes and by (2) performing and evaluating a worldwide survey of earthquake-induced damage to and failure of piping over the past sixty years. Welded steel piping has exhibited superior performance in past earthquakes, even though it is rarely designed to resist earthquakes and is typically designed to resist only normal gravity and pressure loads. Seismic adequacy criteria are developed for the three areas where seismic-induced failure has been observed: seismic anchor movement, interaction and corrosion. It is noteworthy that inertia loads are not known to have caused failure to piping, and thus criteria for inertia loads are not proposed or apparently needed. This finding should be contrasted with the great emphasis placed on seismic design for inertia loads in nuclear plant piping systems. This study presents conclusive evidence that design for inertia effects is over-emphasized on the basis of providing needed additional safety. 12 refs., 12 figs., 2 tabs.

18287 (GKSS—86/E/60) Investigations of after-heat removal pumps. Final report. Wietstock, P.; Domann, H. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude, Germany, F.R.. Inst. fuer Anlagentechnik). (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Anlagentechnik). 1987. 170p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88752229/JAW.

Parameters influencing the pump performance were analysed during stationary and instationary conditions of an original DWR-heat removal pump, which was equipped with special measurement devices. The most important results will be presented by the following: 1) air addition deteriorates pump performance; 2) increasing system temperatures improve cavitation behaviour; 3) instationary tests lead to hysteresis phenomena; 4) pump performance was good within the tested parameter region. With 94 figs..

18288 (IA—1427, pp 26-27) Environmental contamination measured in Israel following the Chernobyl reactor accident. Schlesinger, T.; Biran, T.; Even, O.; Dukhan, R.; Tal, A.; Friedman, K.; Israeli, M. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18289 (IA—1430) Monitoring data related to the Chernobyl accident as measured in Israel during May-July 1986 and the assessment of the radiation doses to the population. Schlesinger, T.; Biran, T.I.; Even, O.; Dukhan, R.; Shamai, Y.; Koch, J.; Tal, A.; Israeli, M. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Jul 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701288/JAW.

Environmental monitoring was undertaken on April 30 1986, to follow the effects of the Chernobyl accident on the quality of the environment in Israel. Measurements of air radioactive contamination were continuously taken to the end of July when air radioactive declined to values below 0.01 Bq/m/sup 3/. Along air measurements, radioactive contamination of ground, rain and drinking water, grass, vegetation and food items such as vegetables, fruits, milk, meat etc. were taken as well. Assessment of the accumulated radiation doses due to the Chernobyl accident was conducted. The effective dose equivalent is estimated to be 46 μSv (4.6 mrem).

18290 (INIS-mf—11090) Consequences of the Chernobyl reactor accident in the Greek marine environment. Technical report. Florou, H. (ed.). (National Centre for Marine Research, Athens (Greece)). Feb 1987. 41p. (In Greek). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701313/JAW.

In collaboration with the National Research Centre for Physical Sciences Democritos, Athens (GR).

A sampling network was established around the Greek peninsula including the ordinary monitoring stations, as well as some new ones so that a good ecological and geomorphological coverage was succeeded. The artificial radionuclides of the fallout coming from Chernobyl were measured in fish, crustacea, algae, seagrass, plankton and sea urchins as representative marine organisms of each region. There was an immediate response of the organisms to the added pollutants in their environment evidenced by the rise of the concentrations of the artificial radionuclides, up to ten times in some cases concerning some long lived radionuclides measured before and after the Chernobyl reactor accident. Besides the physical and chemical factors of the environment, as well as the biological parameters of the organisms, the geomorphology and the weathering processing of the region seemed to have a considerable influence on the bioaccumulation of the radionuclides by the various organisms. All the above arguments concern the radioecological aspect while from the radiology point of view the contribution of the polluted seafood to the total dose received by the consumers was negligible in comparison with that via the terrestrial food webs. (H.F.).

18291 (KFK—4286) Probabilistic analysis of crack containing structures with the PARIS code. Brueckner-Foit, A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung). Oct 1987. 89p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751964/JAW.

The basic features of the PARIS code which has been developed for the calculation of failure probabilities of crack containing structures are explained. An important issue in the reliability analysis of cracked components is the probabilistic leak-before-break be-

haviour. Formulae for the leak and break probabilities are derived and it is shown how a leak detection system influences the results. An example taken from nuclear applications illustrates the details of the probabilistic leak-before-break analysis.

18292 **(NRCN(ER)—034) Radiation fallout and assessment of radiation dose to the population of southern Israel following the Chernobyl accident.** Laichter, Y.; German, U.; Levinson, S.; Sberlo, E.; Knimah, J.; Naim, E. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Oct 1987. 33p. (In Hebrew). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701401/JAW.

A continuous fallout sampling and measuring network was established in southern Israel following the May 2nd 1986, indication of radioactivity in rain water. During the month of May, 191 samples were collected and 242 analyses performed. Gamma spectrometric measurements were performed with Ge(Li) and NaI detectors on air samples, milk and water. Additional assessments were carried out with fallout trays, thermoluminescent dosimetry, whole-body counting and direct /sup 131/I-measurements in the human thyroid gland. The estimated commited equivalent effective dose for adults was about 35 μSv, and the commited equivalent dose to the thyroid gland was 520 μSv. These values are much lower than the estimated 2000 μSv annual equivalent effective dose.

18293 **(NUREG—1137-Suppl.7) Safety evaluation report related to the operation of Vogtle Electric Generating Plant, Units 1 and 2 (Docket Nos. 50-424 and 50-425).** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Projects I/II). Jan 1988. 92p. NTIS, PC A05/MF A01 - GPO. Order Number TI88900337/JAW.

In June 1985, the staff of the Nuclear Regulatory Commission issued its Safety Evaluation Report (NUREG-1137) regarding the application of Georgia Power Company, Municipal Electric Authority of Georgia, Oglethorpe Power Corporation, and the City of Dalton, Georgia, for licenses to operate Vogtle Electric Generating Plant, Units 1 and 2 (Docket Nos. 50-424 and 50-425). The facility is located in Burke County, Georgia, approximately 26 miles south-southeast of Augusta, Georgia, and on the Savannah River. This seventh supplement to NUREG-1137 provides recent information regarding resolution of some of the open and confirmatory items that remained unresolved following issuance of Supplement 6, and documents completion of several Unit 1 license conditions.

18294 **(NUREG—1250-Rev.1) Report on the accident at the Chernobyl Nuclear Power Station.** (USDOE, Washington, DC; Electric Power Research Inst., Palo Alto, CA (USA); Environmental Protection Agency, Washington, DC (USA); Federal Emergency Management Agency, Washington, DC (USA); Institute of Nuclear Power Operations, Atlanta, GA (USA); Nuclear Regulatory Commission, Washington, DC (USA)). Dec 1987. 219p. NTIS, PC A10/MF A01 - GPO. Order Number TI88005834/JAW.

This report presents the compilation of information obtained by various organizations regarding the accident (and the consequences of the accident) that occurred at Unit 4 of the nuclear power station at Chernobyl in the USSR on April 26, 1986. Each organization has independently accepted responsibility for one or more chapters. The specific responsibility of each organization is indicated. The various authors are identified in a footnote to each chapter. Very briefly the other chapters cover: the design of the Chernobyl nuclear station Unit 4; safety analyses for Unit 4; the accident scenario; the role of the operator; an assessment of the radioactive release, dispersion, and transport; the activities associated with emergency actions; and information on the health and environmental consequences from the accident. These subjects cover the major aspects of the accident that have the potential to present new information and lessons for the nuclear industry in general. The task of evaluating the information obtained in these various areas and the assessment of the potential implications has been left to each organization to pursue according to the relevance of the subject to their organization. Those findings will be issued separately by the cognizant organizations. The basic purpose of this report is to provide the information upon which such assessments can be made.

18295 **(NUREG/CR—3908) Survey of the state of the art in mitigation systems.** Castle, J.N.; Catton, I.; Dooley, J.L.; Hammond, R.P.; Kastenberg, W.E.; Swanson, D. (R and D Associates, Marina del Rey, CA (USA)). Jan 1988. 127p. (RDA-TR—127302-001). NTIS, PC A07/MF A01 - GPO. Order Number TI88900341/JAW.

The state of the art is reviewed for devices and systems intended to prevent failure of reactor containment structures during severe accidents involving melting of the core. The devices are grouped according to the function they provide, such as core retention, hydrogen control, vent systems, heat removal, etc. Each of the five major types of US containment is then reviewed as to the types and examples of mitigation devices suitable for its special conditions.

18296 **(NUREG/CR—4242) Survey of light water reactor containment systems, dominant failure modes, and mitigation opportunities: Final report.** Castle, J.N.; Catton, I.; Dooley, J.L.; Hammond, R.P.; Kastenberg, W.E.; Swanson, D. (R and D Associates, Marina del Rey, CA (USA)). Jan 1988. 290p. (RDA-TR—127301-002). NTIS, PC A13/MF A01 - GPO. Order Number TI88900340/JAW.

The state of the art of nuclear reactor containment structures is described, and the five major types in the US are compared. For each type, the report analyzes the dominant modes by which a severe accident could cause a containment to fail, the degree of public risk that would result if it did fail, and the feasibility of modifying the system to prevent such failures. The report is the first in a series of five related studies aimed at developing a coherent approach for assessing the practicality, cost and value/impact of a mitigation program for rendering a containment relatively resistant to severe core-melt accidents.

18297 **(NUREG/CR—4243) Value/impact analysis for evaluating alternative mitigation systems.** Kastenberg, W.E.; Catton, I.; Castle, J.N.; Dooley, J.L.; Hammond, R.P. (R and D Associates, Marina del Rey, CA (USA)). Jan 1988. 41p. NTIS, PC A03/MF A01 - GPO. Order Number TI88900343/JAW.

Methods are developed for assessing the cost effectiveness of proposed systems and strategies for mitigating the consequences of severe nuclear accidents. Such mitigation systems consist mostly of devices for improving the ability of a reactor containment to survive such an accident and retain all radioactive materials. Value/impact analysis is applied to the system with and without mitigation, using the population dose averted by mitigation as the value of benefit, and the dollar cost of the containment improvements as the impact. Other considerations affecting such analyses include ways of monetizing public health risk, economic discounting, and the effect of interdiction policy and other post-accident recovery costs.

18298 **(NUREG/CR—4244) Strategies for implementing a mitigation policy for light water reactors.** Kastenberg, W.E.; Hammond, R.P.; Catton, I.; Dooley, J.L.; Castle, J.N. (R and D Associates, Marina del Rey, CA (USA)). Jan 1988. 55p. (RDA-TR—127305-002). NTIS, PC A04/MF A01 - GPO. Order Number TI88900342/JAW.

Possible strategies are considered for implementing a regulatory policy requiring that power reactor containment enclosures be modified to resist severe core-melt accidents without release of radioactive materials. Such modification was found to be feasible, reliable and cost effective in the work reported in previous studies in this NRC series. Incentives, goals, costs and sources of funding are discussed, and a series of possible implementation steps are presented. 11 refs.

18299 **(NUREG/CR—4523) Closeout of IE Bulletin 80-13: Cracking in core spray spargers: [Technical report, December 16, 1985-July 7, 1987].** Foley, W.J.; Dean, R.S.; Hennick, A. (Parameter, Inc., Elm Grove, WI (USA)). Jan 1988. 36p. (PARAMETER/IE—153). NTIS, PC A03/MF A01 - GPO. Order Number TI88900299/JAW.

Between late 1978 and early 1980, the licensees of Oyster Creek and Pilgrim nuclear power stations notified the NRC that

cracks had been found in core spray spargers. In early 1979, General Electric (GE) requested licensees of boiling water reactors (BWRs) to inspect spargers for visual indications of cracking. In March 1980, representatives of GE and the NRC met to discuss sparger cracking. IE Bulletin 80-13 was issued May 12, 1980, to require more intensive inspection of these safety-related systems. Core spray spargers are provided as engineered safety features, for emergency core cooling. Licensees of operating BWRs were required to take four specific actions. Evaluation of licensees' responses and inservice inspection reports, NRC/IE inspection reports and NRC correspondence shows that the bulletin can be closed out for all of the 23 BWR operating facilities which were issued the bulletin for action. Examination of spargers at 22 operating BWRs is required every refueling outage. The licensees have incorporated this examination into their inservice inspection programs. Techniques for inspection of spargers have been improved during the period of bulletin activity. Generic Letter 84-11 establishes the requirement for an ongoing program for inspection of BWR stainless steel piping.

18300 **(NUREG/CR—4688-Vol.2) Quantification and uncertainty analysis of source terms for severe accidents in light water reactors (QUASAR): Part 2, Sensitivity analysis techniques.** Ishigami, T.; Cazzoli, E.; Khatib-Rahbar, M.; Unwin, S.D. (Brookhaven National Lab., Upton, NY (USA)). Oct 1987. Contract AC02-76CH00016. 54p. (BNL-NUREG—52008-Vol.2). NTIS, PC A04/MF A01 - GPO. Order Number TI88005035/JAW.

Existing methods for sensitivity analysis are described and new techniques are proposed. These techniques are evaluated through consideration relative to the QUASAR program. Merits and limitations of the various approaches are examined by a detailed application to the Suppression Pool Aerosol Removal Code (SPARC). 17 refs., 7 figs., 12 tabs.

18301 **(NUREG/CR—4924) Seismic Category I Structures Program: Final report, FY 1983-84.** Dove, R.C.; Bennett, J.G.; Farrar, C.; Anderson, C.A. (Los Alamos National Lab., NM (USA)). Sep 1987. Contract W-7405-ENG-36. 90p. (LA—11013-MS). NTIS, PC A05/MF A01 - GPO. Order Number TI88006078/JAW.

This report summarizes the results obtained from a series of simulated seismic tests on scale models of a prototypical Category I nuclear power plant auxiliary building, representing a reinforced concrete, diesel generator building. Two sizes of model structures were used: 1/10 scale and 1/30 scale. Model construction, test methods, instrumentation, data reduction techniques, experimental results, comparison of experimental and computed results, and conclusions are presented in this report. Values of structural stiffness obtained from both static and dynamic tests are found to be significantly lower than values of stiffness computed using the usual design methods. Values of modal frequency obtained from dynamic tests are compared to computed values. Decreasing modal frequencies with increasing seismic input are reported. The effective damping of these test structures is determined from the test results. The results obtained from the two different size (1/10- and 1/30-scale) models are compared. 10 refs., 31 figs., 8 tabs.

18302 **(NUREG/CR—4991) Evaluation and proposed improvements to effectiveness of US Nuclear Regulatory Commission generic communications.** Thurber, J.A.; Melber, B.D.; Geisendorfer, C.L.; Vallario, R.W. (Battelle Human Affairs Research Centers, Washington, DC (USA); Pacific Northwest Lab., Richland, WA (USA)). Jan 1988. Contract AC06-76RL01830. 62p. (PNL—6289; BHARC—700/87/016). NTIS, PC A04/MF A01 - GPO. Order Number TI88005711/JAW.

This report describes an evaluation of NRC generic communications with industry concerning safety related issues of commercial nuclear power plandts. The analysis builds on the findings presented in the 1986 Office of Analysis and Evaluation of Operational Data (AEOD) Special Study Report, "An Overview of Nuclear Power Plant Operating Experience Feedback Programs" (AEOD/S602). The primary objective of the report is to present practical recommendations for improving NRC's documents and generic communications system. The report is based upon a systematic review and evaluation of NRC and industry operating experience documents. It also includes an analysis of interviews with licensee personnel at five utilities and their nuclear power plants. NRC regional and headquarters managers and staff were also interviewed for the study. NRC and licensee personnel interviewed are generally satisfied with the current NRC-industry communications system; however, several problems and potential solutions to those problems are identified in this study. The report makes seven major recommendations for improvement in the effectiveness of NRC-industry generic communications about nuclear power plant operating experience.

18303 **(NUREG/CR—5084) IFCI: An Integrated code for calculation of all phases of Fuel-Coolant Interactions.** Young, M.F. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1987. Contract AC04-76DP00789. 55p. (SAND—87-1048). NTIS, PC A04/MF A01 - GPO. Order Number TI88005325/JAW.

The IFCI (Integrated Fuel-Coolant Interaction) code was developed to investigate the interaction of hot molten materials with water in as mechanistic a manner as possible. This report describes the key features of IFCI, such as dynamic fragmentation and surface area transport, and describes the results of the first IFCI test problem. The test problem is a simulation of an experiment from the Fully Instrumented Test Series (FITS) in which 20 kg of molten iron-alumina thermite was poured into a tank of water. 30 refs., 16 figs., 2 tabs.

18304 **(PB—88-126982/XAB) Evaluation of engineering leak-before-break assessment methods by piping tests.** Talja, H. (Helsinki Univ. of Technology, Espoo (Finland). Lab. of Engineering Materials). May 1987. 27p. (REPT—1/87). NTIS, PC E03/MF A01.

Battelle's method is a simple and feasible tool for assessing the leak before breakage of ductile piping components occurs. In this report, the applicability and reliability of the method are assessed by evaluating a number of piping tests performed by Imatra Power Company. Furthermore, a simple method for calculating upper and lower bounds for leak areas is discussed.

18305 **(PB—88-140033/XAB) Presentation of results of limited operations robot research and development.** (Advanced Robot Technology Research Association, Tokyo (Japan)). Dec 1987. 121p. NTIS, PC E07/MF E07.

The Project was initiated in 1983 and is scheduled to run through 1990. Emphasis is being given to the development of: (1) robots capable of performing inspection, maintenance, and repair tasks in the high-radiation environment of a nuclear power plant; (2) robots capable of high-level operations in the three-dimensional underwater environment of an off-shore platform; and, (3) robots designed for disaster prevention and control, and rescue operations in a petrochemical plant. The document provides a detailed overview of the Projects and descriptions of accomplishments so far.

18306 **(PNL-SA—15069) Using cost/risk relationships in restoring radiologically contaminated sites.** Tawil, J.J. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 22p. (CONF-8710259—1; IAEA-CN—48/285). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005156/JAW.

From International conference on nuclear power performance and safety; Vienna, Austria (1 Oct 1987).

In the event of a major radiological accident at a nuclear power plant, large populated areas could become severely contaminated. In the United States of America, local public officials would have the responsibility of establishing radiation recovery criteria or cleanup levels that would allow the displaced members of the population to return safely to their jobs and homes. The range of acceptable criteria could imply variations in property losses in the billions of dollars. Given the likely public concern over the health consequences, and the magnitude of the potential property-related losses, a cost/risk analysis can provide important input to establishing the recovery criteria. This paper describes procedures for conducting a cost/risk analysis, using the Indian Point reactor site in New York State as a case study. The procedures are illustrated

with the aid of computer software developed for determining the property and health effects of major reactor accidents. The software is also used to demonstrate how a decontamination plan might be developed by evaluating a number of alternative decontamination strategies. 6 refs., 2 figs., 7 tabs.

18307 **(RL—153-85) Behaviour of a PWR with core protection system (SSN) in case of accidents due to power failure, ATWS and steam generator rupture.** Boncompagni, S.; Fulceri, P.; Oriolo, F. (Pisa Univ. (Italy). Dipt. di Costruzioni Meccaniche e Nucleari). 1985. 49p. (In Italian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701405/JAW.

Four Appendixes.

The results of the analysis of the transient fallowing internal and external power failure, without scram, in the nuclear power plant of the Italian Unified Nuclear Project are examined. The availability of ECCS is excluded while the breakage of a tube in each steam generator is supposed, togheter with the presence of an original safety system known as SSN (core protection system). Computations have been performed by using Mark 6 RELAP4 code. The study of the transient and the physical model used are briefly illustrated. Finally the results achieved are analysed.

18308 **(RL—155-85) Analysis of the AD sequence in Zion plant using the March 1.1 code.** Oriolo, F.; Paci, S. (Pisa Univ. (Italy). Dipt. di Costruzioni Meccaniche e Nucleari). 1985. 21p. (In Italian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701406/JAW.

The analyses of the AD sequences for the Zion power plant, made at the Pisa University, in the framework of the participation in the Source Tern Working Group. After a short description of the plant and the sequence under analysis, the model used for the reference computation and the results obtained using the March 1.1 code are shown. Together with the reference computation a series of parametric tests have been also made, concerning some input code variables, in order to ascertain their influence on the transient trend. The results of these analyses are shown in Appendix.

18309 **(RTR—2424-Del.Ver.) Hydraulic transients for loss of coolant accidents.** Hinton, J.H. (Savannah River Lab., Aiken, SC (USA)). 19 Dec 1986. Contract AC09-76SR00001. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005555/JAW.

This paper discusses calculations related to hydraulics in a loss of coolant reactor accident. Earlier calculations ignored the effect of emergency coolant injection. Present results show that if the ECS flow is considered, reactor coolant flow is maintained for much longer periods. A computer program used to carry out the calculations is included in this report. (JDH)

18310 **(RTR—2431-Del.Ver.) Subcycle-specific emergency cooling limits.** Giess, M.J. (Savannah River Lab., Aiken, SC (USA)). 8 Dec 1986. Contract AC09-76SR00001. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005579/JAW.

Assembly power limits are prescribed for each reactor charge so that the Emergency Cooling System (ECS) will prevent core damage from exceeding specified damage limits during a postulated loss-of-coolant (LOCA) or loss-of-pumping (LOPA) accident. Generic assembly power limits which include a 10% uncertainty factor have been determined for the Mark 16B-31 charge. However, future power limits will not be based on the values, because a new damage model is being developed. These limits can be determined at present if the minimum assembly flows during a LOCA are known.

18311 **(SAND—87-2277C) Uncertainties in hydrogen combustion.** Stamps, D.W.; Wong, C.C.; Nelson, L.S. (Sandia National Labs., Albuquerque, NM (USA)). Oct 1987. Contract AC04-76DP00789. 26p. (CONF-8710111—28). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005354/JAW.

From 15. water reactor safety information meeting; Gaithersburg, MD, USA (26 Oct 1987).

Three important areas of hydrogen combustion with uncertainties are identified: high-temperature combustion, flame acceleration and deflagration-to-detonation transition, and aerosol resuspension during hydrogen combustion. The uncertainties associated with high-temperature combustion may affect at least three different accident scenarios: the in-cavity oxidation of combustible gases produced by core-concrete interactions, the direct containment heating hydrogen problem, and the possibility of local detonations. How these uncertainties may affect the sequence of various accident scenarios is discussed and recommendations are made to reduce these uncertainties. 40 refs., 8 figs., 2 tabs.

18312 **Distributions for binomial failure rate parameters.** Atwood, C.L. (EG and G Idaho, Inc., Idaho Falls, ID 83415). *Nuclear Technology;* **79**: No. 1, 66-81(Oct 1987).

Past reports have estimated occurrence rates for certain multiple failure events. These reports are based on the binomial failure rate (BFR) common cause model and on licensee event report data. Uncertainty distributions for the four basic BFR parameters formed the basis of the past reports. These distributions are tabulated, and from them an analyst can estimate, with uncertainty bounds, the rate or probability of a quite arbitrary multiple failure event. No longer is there a restriction to those events for which rates have been published.

18313 **Developing sensor-driven robots for hazardous environments.** Trivedi, M.M.; Gonzalez, R.C.; Abidi, M.A. (Dept. of Electrical and Computer Engineering, The Univ. of Tennessee, Knoxville, TN 37996-2100). pp 185-189 of Applications of artificial intelligence V. Gilmore, J.F. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1987). (CONF-8705203—).

From 5. applications of artificial intelligence; Orlando, FL, USA (18 May 1987).

Advancements in robotic technology are sought to provide enhanced personnel safety and reduced costs of operation associated with nuclear power plant manufacture, construction, maintenance, operation, and decommissioning. The authors describe main characteristics of advanced robotic systems for such applications and suggest utilization of sensor-driven robots. Research efforts described in the paper are directed towards developing robotic systems for automatic inspection and manipulation of various tasks associated with a test panel mounted with a variety of switches, controls, displays, meters, and valves.

18314 **Validation of a model for faster-than-real-time LMFBR core transient analysis.** Tzanos, C.P. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **54**: 167-168(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

A model was previously presented for faster-than-real-time liquid-metal fast breeder reactor (LMFBR) core transient analysis for purposes of continuous on-line data validation, plant state verification, and fault identification. For validation of this model, the TREAT experiment TS-1C was analyzed. This paper presents the results of this analysis.

18315 **Operational lessons learned during decommissioning.** Mullee, G.R. (General Electric Co., Shippingport, PA). *Transactions of the American Nuclear Society;* **54**: 45-46(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

The Shippingport Atomic Power Station is being decommissioned by the US Dept. of Energy (DOE). The General Electric Co. is under contract to the DOE as the decommissioning operations contractor (DOC). The DOC has instituted a system for evaluating abnormal events and reporting the lessons learned. In addition to the reporting of unusual occurrences (events with programmatic significance) required by DOE orders, the Shippingport Station Decommissioning Project (SSDP) abnormal event evaluation system also includes less serious events and near-misses. The system has the objectives of contributing toward the maintenance of a safe work environment and providing information for future projects through the technology transfer program. This paper describes the abnormal event evaluation system, reports the lessons learned, and concludes that the attention directed to evaluation/

correction of near-misses has been effective-there have been no serious events.

18316 **Barge transportation of reactor pressure vessel and other low specific activity waste.** Yannitell, D.M. (General Electric Co., Shippingport, PA). *Transactions of the American Nuclear Society;* **54**: 46-48(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

The Shippingport Station Decommissioning Project is a US Dept. of Energy sponsored project to dismantle the Shippingport Atomic Power Station and return the government-leased property in a radiologically safe condition to its owner, the Duquesne Light Co. All radioactive material removed from the station will be transported to and buried at the government-owned Hanford Reservation in Richland, Washington. Based on economic and safety considerations, the majority of the radioactive material, including the one-piece reactor pressure vessel/neutron shield tank (RPV/NST) package, will be shipped by barge. The American National Standard Subcommittee N14.24 on Domestic Barge Transport of Highway Route Controlled Quantities of Radioactive Materials expect that barge transport can play an important role in transporting contaminated equipment and structures from decommissioned nuclear facilities. This will be the first US use of barge transportation for large-scale transport of radioactive materials from a decommissioned nuclear facility. This application may well set the precedent for future domestic nuclear decommissioning activities.

18317 **Quality assurance program for decommissioning.** Briggs, P.M. (General Electric Co., Shippingport, PA). *Transactions of the American Nuclear Society;* **54**: 50(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

Defining the quality assurance program for the US Dept. of Energy Shippingport Station Decommissioning Project (SSDP) was a unique opportunity because this is the first full-sized commercial nuclear power plant to be decommissioned. General Electric Co. defined a quality assurance program that provided adequate control, yet was stripped down to the essentials. The program is designed to provide a flexible degree of monitoring of subcontractor work, built around a core of radiation safety monitoring, detailed planning, inspection, and auditing, and operated with a minimum of dedicated personnel. This paper concentrates on the traditional quality assurance activities.

18318 **TMI-2 core damage.** Eidam, G.R.; Worku, G. *Transactions of the American Nuclear Society;* **54**: 80-81(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

On March 28, 1979, the Unit 2 reactor at Three Mile Island (TMI) underwent an accident that resulted in severe damage to the reactor's core. A core damage examination program is essential to understanding the unique conditions and for developing work plans and tools in advance of each portion of the reactor disassembly / defueling effort. To characterize the conditions, the reactor vessel was divided into five regions requiring varied approaches to defueling, because each contains a unique configuration and formation: (1) upper core region, (2) mid-core region, (3) lower core region, (4) lower core support assembly region, and (5) lower heat region. The original core inventory included ~ 93,000 kg of fuel and 35,000 kg of structural and neutron absorber material for a total of 128,250 kg. Assuming that 90% of the hydrogen generated during the accident was due to reduction of the coolant and accounting for portions of the upper plenum structure that melted, the total postaccident core material comes to ~ 131,850 kg. As of January 9, 1987, 29,000 kg of the material had been defueled.

18319 **TMI-2 fuel removal operations.** Frew, J.E.; Hultman, C.W.; Pastor, M.K. *Transactions of the American Nuclear Society;* **54**: 81-83(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

As a result of the damage that occurred to the Three Mile Island Unit 2 core during the accident in March 1979, removal of the fuel by normal fuel defueling methods was not possible. A program was developed to remove the fuel using special tools and equipment. In addition, the fuel transfer system was upgraded for improved reliability, and the fuel handling bridges in the reactor building and fuel handling building were modified to transfer the loaded canisters in air from the reactor vessel to the fuel transfer system and from the fuel transfer system to the new fuel storage racks. Defueling was performed by control room operators and auxiliary operators under the supervision of six specially licensed fuel handling senior reactor operations. A defueling test assembly was set up on the turbine building. This facility provided a realistic mock-up of the shielded work platform and defueling tools. The defueling program was based on being able to see via closed circuit television to engage tools to remove core debris.

18320 **Plasma-arc cutting equipment for TMI-2 defueling.** Austin, W.E.; Blumberg, R.; Hayes, J.H. *Transactions of the American Nuclear Society;* **54**: 83-85(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

An engineering effort is currently under way at Three Mile Island Unit 2 (TMI-2) to provide equipment to defuel the region of the reactor vessel below the core. This area is a stainless steel structure called the lower core support assembly (LCSA). As one of several options, the plasma-arc cutting process has been selected to section the LCSA to provide large openings for debris removal from this region. Plasma arc is the only technique considered to be capable of cutting the LCSA in a reasonable time. Remote, underwater plasma cutting has been used previously for decommissioning and for modifications at operating reactors, such as St. Lucie. Cutting tests at a depth of 10.7 m (35 ft) on 5-cm (2-in.)-thick stainless steel established the feasibility of the TMI-2 application.

18321 **Ex-vessel defueling for TMI-2.** Wolfgang, R.J.; DiGiacomo, L.; Ammenheuser, R.N. *Transactions of the American Nuclear Society;* **54**: 87-88(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

As a consequence of the Three Mile Island Unit 2 (TMI-2) accident, the fuel was severely damaged, and fuel fines and fuel rubble were transported throughout the reactor coolant system (RCS) and to other systems connected to the RCS. Estimates of the quantity of fuel in equipment and piping outside the reactor vessel boundary have been developed based on component specific methods, such as sampling, monitoring by camera, and gamma spectroscopy. To ensure a safe, stable plant configuration during the post-defueling monitored storage (PDMS) phase, fuel must be removed from any area if the potential for criticality exists. The fuel quantity estimate is therefore used as a simple guideline to indicate potential need to removal fuel from ex-vessel locations. The juxtaposition of multiple fuel containing components is also considered. Components that have been considered as candidates for possible fuel removal are shown, and their estimated fuel quantities are listed. Three systems have been designed to defuel three specific ex-vessel areas: the pressurizer defueling system, the pressurizer spray line defueling system, and the plenum defueling system.

18322 **(INIS-XN—85) Administrative order of 27 April 1987 amending the Administrative Order of 21 June 1984 (Stb 341) and increasing the limit of liability pursuant to Section 3, subsection 2 of the Nuclear Liability Act (Stb 1979, 225).** (International Atomic Energy Agency, Vienna (Austria)). 28 Apr 1987. 2p. (In Dutch). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701320/JAW.

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Under this General Administrative Order, as from 1 June 1987, the maximum amount of liability of a nuclear operator in the Netherlands is increased from 200 million to 400 million guilders. Over and above this amount, compensation out of public funds up to an aggregate amount of 1 billion guilders remains unaffected (NEA).

25 ENERGY STORAGE

2501 Magnetic

REFER ALSO TO CITATION(S) 18863

2502 Compressed Gas

REFER ALSO TO CITATION(S) 18328

2503 Pumped Hydro

REFER ALSO TO CITATION(S) 18328

2506 Thermal

18323 **(AFME—83-2458-2) Energy recovery system with underground storage pilot project.** Calvet, P.; Ferries, B.; Berthoumieu, P. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1985. 105p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751076/JAW.

A pilot project for space heating and hot water production energy conservation is presented. The rejected heat from the building cooling system and solar collectors during summer, together with the heat produced by a heat pump connected to the canal du Midi (a waterway in France) can be stored for a seasonal storage in the ground through vertical heat exchangers. In this paper a heat demand and resource evaluation of the building and site is given; the geotechnic and thermal evaluation of the soil and the storage design are presented. The performances and cost/benefit analysis of this system are also compared to those of alternative solutions.

18324 **(EPRI-EM—5545) Water treatment technologies for thermal storage systems: Final report.** Ahlgren, R.M. (Ahlgren Associates, Waukesha, WI (USA)). Dec 1987. 85p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920128/JAW.

Water has many properties which make it an almost ideal medium for storage and transfer of cooling energy. However, even pure water cannot be used in cooling thermal storage systems without careful attention to water chemistry management. There are three water conditions which may cause problems in cooling systems: corrosion, biofouling, and sludge deposits. Corrosion and biological fouling are usually the most common problems, but both can be readily controlled by suitable internal chemical treatment. Starting a system with good pre-operational cleaning procedures is essential and is probably the best route to long-term waterside efficiency and trouble-free performance. A wide variety of reference materials, professional and educational assistance, and water treatment chemical supplier support is readily available. The direct costs of good chemical management are not high and are a good investment when compared to the expenses that might be incurred if no attention is paid to system water chemistry. This discussion is not intended to be a detailed technical treatise on water chemistry or engineering technology. Rather, it is intended to serve as an introduction and interpretation of how good water treatment practice can be applied to, and benefit, thermal storage system operations. 3 figs., 11 tabs.

18325 **(PNL—6372) An assessment methodology for thermal energy storage evaluation.** Brown, D.R.; Dirks, J.A.; Drost, M.K.; Spanner, G.E.; Williams, T.A. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1987. Contract AC06-76RL01830. 107p. NTIS, PC A06/MF A01; GPO Dep. Order Number DE88004642/JAW.

This report documents an assessment methodology for evaluating the cost, performance, and overall economic feasibility of thermal energy storage (TES) concepts. The methodology was developed by Thermal Energy Storage Evaluation Program personnel at Pacific Northwest Laboratory (PNL) for use by PNL and other TES concept evaluators. The methodology is generically applicable to all TES concepts; however, specific analyses may require additional or more detailed definition of the ground rules, assumptions, and analytical approach. The overall objective of the assessment methodology is to assist in preparing equitable and proper evaluations of TES concepts that will allow developers and end-users to make valid decisions about research and development (R and D) and implementation. The methodology meets this objective by establishing standard approaches, ground rules, assumptions, and definitions that are analytically correct and can be consistently applied by concept evaluators. 15 refs., 4 figs., 13 tabs.

18326 **Rotesco - 50/50: A thermal energy storage concept for the temperature range -50°F to +50°F.** Rockenfeller, U.; Horn, G.; Langeliers, J. (Rocky Research Corp., Boulder City, NV). pp 1308-1316 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—).

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879373.

The use of coordinative complex compounds as reaction thermal energy storage material makes it possible to design a single hardware concept that covers the entire chill and cool storage temperature range from -50°F to +50°F and can also serve as heat storage and heat pump equipment up to 1500°F. The exploitation of the solid-vapor chemisorption reaction yields energy densities approximately twice as high as conventional ice storage systems. The complex compounds considered in this paper are solid-vapor compounds consisting of a metal inorganic salt and a so-called ligand refrigerant. The ligand is adsorbed by the salt in a chemisorption process and bonded in large coordination spheres. The coordinative characteristic of these complexes allows for the adsorption of ligand refrigerant at constant pressure and temperature within each coordination polyhedron.

2508 Chemical

REFER ALSO TO CITATION(S) 18328, 18810

18327 **(EUR—10876) Energy storage and transport by reversible chemical reactions.** Beghi, G. (Commission of the European Communities, Ispra (Italy)). 1987. 38p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900370/JAW.

Reversible thermochemical reactions are one of the possibilities to store and transport high temperature heat (800°K up to 1300°K). There are open cycles and closed cycles. Some reversible systems are described, as the SO_2-SO_3 system. A typical example of open cycle is the reaction for water decomposition. Results of a pilot plant to verify the decomposition of sulfuric acid are described; the technological feasibility of this method for hydrogen production is shown. The possibility to use other high temperature sources, as solar energy is discussed. 5 figs., 1 tab.

2509 Batteries

REFER ALSO TO CITATION(S) 18006, 18134, 18531

18328 **(PNL-SA—14873) Life-cycle cost projections for utility load-leveling systems.** Humphreys, K.K.; Brown, D.R. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 18p. (CONF-871027—42). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003413/JAW.

From 172. meeting of the Electrochemical Society; Honolulu, HI, USA (18 Oct 1987).

Life-cycle cost estimates have been prepared for nine battery, fuel cell, and conventional technologies applicable to utility load-leveling systems. The estimates are based on a 100 MWh, 20 MW facility. It is presumed to be operated by an investor-owned utility 250 cycles per year. Cost and performance data gathered from a review of load-leveling system analyses were adjusted to common ground rules and combined with financial and energy cost data to produce life-cycle estimates. 5 refs., 1 fig., 6 tabs.

18329 **(LBL—21343) Improve the lifetime of the hollow fiber sodium sulfur cell: Final report.** Pierini, P.; Nielsen, C.; Tsang, F. (Dow Chemical U.S.A., Walnut Creek, CA). Aug 1987. Contract AC03-76SF00098. 103p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88004881/JAW.

This report is a continuation of work directed towards identifying potentially superior glass compositions for use as an electrolyte in the Dow sodium-sulfur cell. Prior work identified a glass candidate (T806) having superior resistance to metallic sodium and sodium polysulfides. However, lifetime testing of this glass was disappointing: mean lifetimes are only a few weeks for T806 cells versus ca. six months for cells employing the standard glass (D406). Thermodynamic calculations showed possible reactivity between the above mentioned glasses and sulfur. Work was undertaken in this report to test the hypothesis that T806 cells were failing sooner because of a more rapid reaction with sulfur. Glass-sulfur reactivities were measured at 300°C and 400°C by means of a sensitive ion chromatography method for fifteen glass compositions also in the ternary system: sodium oxide/boron trioxide/silicon dioxide system. Detailed comparisons of sulfur reactivities for T806 and D406 glass compositions permit the rejection of the above hypothesis. In addition, no clearly superior glasses of acceptable sodium ion conductivity were identified with respect to sulfur corrosion. Additional experiments are suggested that may shed light on the early failure of cells using T806 glass as the electrolyte. Attention is drawn to the possible involvement of the cathode foil, molybdenum coated aluminum foil. Specific experiments designed to test the influence of cathode foil are outlined. 11 refs., 15 figs., 8 tabs.

18330 **(LBL—23960) Technology base research on zinc/air battery systems: Final report.** Sierra Alcazar, H.B.; Nguyen, P.D.; Pinoli, A.A. (Pinnacle Research Inst., Cupertino, CA (USA)). Sep 1987. Contract AC03-76SF00098. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004893/JAW.

The capacity extension of additives was tested in a 200 cm^2bi-cell and a Zn powder moving-bed slurry. It was found that for the Type A additives in 12 M KOH, 25 g/l of silicate provided higher capacity than stannate, titanate and aluminate additives. The optimum concentration of sorbitol (a Type B additive that stabilizes polymeric chains involving ZnO) was found to be 15 g/l in 12 M KOH. A silicate and sorbitol combination added to Zn powder slurry in 12 M KOH provided a 20% increase in discharge capacity (195 Ah/l at 200 A/cm^2) compared to the maximum capacity obtained with silicate alone. A much lower capacity (74 Ah/l) was realized with silicate as Type C additive (precipitation of ZnO away from the Zn surface, for low KOH concentrations). The mechanisms of passivation and capacity extension were discussed and a model presented. The cell voltage and power densities were determined for the discharge process as a function of (a) current densities, (b) cathode depolarizer (air or oxygen), and (c) type of slurry (Zn powder or Zn coated polymeric bead). Air depolarization was observed to decrease the maximum power densities of both slurry types. The power densities obtained with Zn powder slurries were higher at all current densities investigated than those obtained with Zn coated polymeric beads (Zn-powder peak power densities more than doubled peak power densities obtained with Zn coated polymeric beads). The recharge process was studied with a planar electrode and with a rotating cylinder electrode. The current efficiency and cathode potentials were determined for glassy carbon and Mg cathodes. The dendritic Zn deposits were mechanically removed from the rotating cylinder electrode with fixed blades. Mechanical removal proved to be unsatisfactory in the embodiment investigated due to preferential dendritic growth on the baldes. Further investigations of discharge cell designs are underway. 19 refs., 40 figs., 5 tabs.

18331 **(LBL—24244) A novel class of positive electrodes for rechargeable batteries.** Mailhe, C.C. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 139p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88004559/JAW.

A novel class of organosulfur positive electrodes for intermediate temperature rechargeable batteries is described here. High temperature batteries such as sodium/sulfur exhibit alluring and unrivaled power and energy densities but unfortunately are plagued by corrosion problems. A decrease in the operating temperature from 350°C to the 110 to 150°C temperature range resulted in a simplified cell technology allowing for the use of polymeric seals. The non-aggressive nature of the positive electrode lessened also considerably the corrosion issues. A tetraethylthiuram disulfide/diethyldithiocarbamate cell was first investigated because of its attractive theoretical energy density of 360 Wh/kg and because of the low melting point of the diethyldithiocarbamate sodium salt (145°C), condition necessary to maintain the electrode in the liquid state. (Sodium and Beta" Alumina were respectively the negative electrode and the solid electrolyte). The low melting sodium salt requirement can be advantageously replaced by the use of a solvent in charge of solubilizing the sodium salt generated during discharged. Low viscosity and high dielectric constant were identified as two key factors in the solvent optimization. The addition of 20% in weight of dimethyl sulfoxide or of sulfolane permitted the cell charge and discharge at 5 mA/cm^2 at 130°C. Peak current densities of 100 mA/cm^2 at 1 Volt were also obtained. The perspectives opened by solvent addition, led to the concept of "electroactive solvent" where the electroactive material itself solvates the sulfide sodium salt. In this respect, the alkoxyalkyl disulfides are promising candidates because of their combined low viscosity, high energy density and thermal stability. 42 refs., 47 figs., 4 tabs.

18332 (NP—8770039, pp 409-429) **Research and development of advanced type battery energy storage system.** Sugioka, Jun'ichi. (The Kansai Electric Power Co., Inc., Osaka, Japan). 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

This research has been made by the joint work of Kansai Electric, Toshiba, and Japan Storage Battery. Targets of development are; 1,000 KW class capacity, 8 hour charge and discharge time respectively, overall energy efficiency above 70%. Its life should be more than 1,500 cycles of charge and discharge, and 10 year depreciation period. And the system must satisfy all the environmental standards. Research targets are to make the system compact, long life, high energy efficiency, and low cost. This power storage system must eventually satisfy the following conditions. (1) System economy must be equal or superior to the hydraulic power generation. (2) Plant must be located in the city or vicinity. (3) Plant area must be equal or less than that of the transformer substation. (13 figs, 9 tabs)

18333 (NP—8770044, pp 403-430) **Development of an advanced type battery energy storage system. Development of sodium-sulfur battery.** Kita, Akira. (Yuasa Battery Co. Ltd., Takatuki, Japan). 21 Sep 1984. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

In Proceedings of parallel sessions for the 4th NEDO general assembly.

This is an annual report for 1983 on the research design, trial making, and testing of electrode and cell construction, and on the conceptual design of a MW class cell. Concerning the anode metal, although a cell-life test is yet being continued for various materials, a Cr-diffused material appears best at the present stage. As to the bonding process, a thermo-compression bonding was evaluated superior to a glass-bonding. As to the anode construction, a double layer graphite proved superior to a mono-layered one on the basis of the data on electric current distribution and on the charging characteristics. From the safety viewpoint,ametal fiber system was superior to a safety-tube system. A large solid electrolyte tube was designed and trially made; check of various characteristics proved the tube of satisfactory performance. Design and trial making of a 300 Ah cell by elongating the length of the electrolyte tube to 400 mm proved to attain an expected performance. On the basis of above data, a 1 KW class cell was trially made by examining the cell configuration and control using a 150 Ah cell; an energy efficiency of 85.9 % was attained. In order to develop a MW class cell, a conceptual design of 10 KW class cell was made based on the concept of a modular cell. (25 figs, 10 tabs)

18334 (NP—8770044, pp 431-451) **Development of an advanced type battery energy storage system. Development of zinc-bromide battery.** Horie, Toshio. (The Furukawa Electric Co. Ltd., Tokyo, Japan). 21 Sep 1984. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

In Proceedings of parallel sessions for the 4th NEDO general assembly.

This is a report for 1983 concerning the development of an electrode, shape improvement of an electrode frame, and design manufacture, and operation of 1 KW class cell. Evaluation of four types of graphite plate for a zinc electrode was made finding a method to prevent the precipitation of dentolite. Development of porous graphite for a chlorine electrode was proceeded. Molding conditions were studied by examining the assembly of a bi-polar cell and the deformation of the compressed electrode, as well as the frame configuration. Operating condition was checked especially for the influence of the inliquid chlorine concentration during the charging, and a gas-liquid separator was devised for lowering the concentration. Concerning the gas-liquid circulating apparatus, required amount of cold water and refrigerating capacity of the chlorine hydration vessel were calculated. Calculation of a pump power in relation with lamination number of the electrode and of the power loss due to the sneak current was made. On the basis of the above results, a 1 KW class cell and a testing equipment was made and operated. Chlorine concentration during the charging was maintained by equipping a gas-liquid separator. Optimum values of the concentration of salt and the temperature of the electrolytic solution. (21 figs, 9 tabs)

18335 (NP—8770044, pp 452-472) **Development of an advanced type battery energy storage system. Development of zinc-bromide battery (2).** Kanasashi, Motonori. (Meidensha Electric Mfg. Co. Ltd, Tokyo, Japan). 21 Sep 1984. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

In Proceedings of parallel sessions for the 4th NEDO general assembly.

This is a report for 1983 on such elemental technology as electrode, separator, and battery electolyte, and an improving and testing of 1 KW class cell. Concerning the bromine electrode, change in the over-voltage was checked for 3 types of surface-treated carbon plastic electrode. Concerning the zinc electrode, efficiency improvement was aimed by changing the manufacturing process and by applying a surface treatment. Concerning the electrolytic solution, change in the cell characteristics was checked by varying the concentration and the temperature; concentration of 2 - 2.5 mol/l and temperature of 20 - 30°C were found appropriate. Concerning the up-scaling of the cell, material, manufacturing method, and performance of both electrode with a frame and separator were checked. An injection molding was found good in practice. A 1 KW class cell was trially made and tested by increasing the number of layers wherein the energy efficiency reached a target value of 80 %. (19 figs, 5 tabs)

18336 (NP—8770045, pp 399-416) **Development of an advanced type battery energy storage system. Redox flow type battery.** Yoshitake, Masami. (Mitsui Engineering and Shipbuilding Co., Ltd., Chiba, Japan). 20 Sep 1985. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

In Proceedings of parallel sessions for the 5th NEDO general assembly.

This research was performed as one of the studies funded by NEDO. The study was advanced by the Electronic Technology General Research Institute as a part of Moon-light Program when it was started in 1980 to develop a new battery, and the technology was, subsequently transferred to the Mitsui Shipbuilding Company who secured the contract from NEDO to make progress on the development of the battery module technology, the research for the scale up technology and the R and D on design, trial manufacture and tests. Namely, on the development of the battery module technology; battery optimization technology was studied, and in this study, on the electrode, the coulomb efficiency for charge and discharge, the improvement of the voltage efficiency and the long term durability of the performance was studied. The time transiting change of the cell resistance was measured and the characteristic on the life estimated, and in consequence, it was decided to adopt an electrode of the Chemically Modified Felt type. It is necessary to develop a new partition plate with a high performance for the 10 kw class battery and the three types made of polyethylene, carbon cloth with a high strength and a glassy carbon plate were studied. (11 figs, 7 tabs)

18337 **Power performance of high-temperature Li-alloy/FeS/sub 2/ bipolar cells in short pulses.** Redey, L. (Chemical Technology Div., Argonne National Lab., 9700 South Cass Avenue, Argonne, IL 60439-4837). pp 1091-1096 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—). Contract W-31-109-ENG-38.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879328.

A new class of the lithium-alloy/metal-disulfide secondary cells--cells that are characterized by a thin, bipolar cell construction, and very high specific power and power-to-energy ratio (termed "galvanic capacitors")--has been developed and studied with regard to their power capability and operational principles. Several versions of these cells (varied in their chemistry and geometry) were investigated in 0.1- to 1000-ms high-intensity (3 to 50 A/cm/sup 2/) current pulses. A 25-W/cm/sup 2/ peak power, 200-kW/dm/sup 3/ power density, and 350-Wh/dm/sup 3/ energy density have been achieved in repetitive 1- to 10-ms pulses and in several cycles for Li-Al/FeS/sub 2/ galvanic-capacitor cells. In investigating the operational principles of this system, the authors found that (1) the power of well-designed battery cells is controlled by the ohmic resistances of the cell components when the current pulses are shortened to less than 10 ms, and (2) the voltage loss vs. current density relationship at any specified state of discharge is nearly linear if the voltage-loss values are compared at identical times of the pulses of the different current densities. On the basis of the latter finding, a precise and simple way is proposed to measure, characterize, and compare various power-performance indicators of bipolar battery cells.

18338 **Molten salt battery advances.** Kaun, T.D.; Redey, L.; Nelson, P.A. (Chemical Technology Div., Argonne National Lab., 9700 South Cass Avenue, Argonne, IL 60439-4837). pp 1085-1090 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—). Contract W-31-109-ENG-38.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879329.

In recent years, development of Li-alloy/metal sulfide cells with molten-salt electrolyte for high performance applications has concentrated on improvement of the electrode performance and cell capacity stability. New electrochemistries and porous electrode compositions have provided a strong foundation for further development of Li-alloy/dense upper-plateau (U.P.) FeS/sub 2/ (1.75 V) cells, as well as Li-alloy/FeS (1.32 V) cells. (U.P. FeS/sub 2/ refers to the discharge reaction of FeS/sub 2/ to Li/sub 2/FeS/sub 2/). A lithium-limited FeS cell has demonstrated 100 Wh/kg at a 3-h rate and 100 W/kg at 80% depth of discharge (DOD), while a dense U.P. FeS/sub 2/ cell is now capable of 175 Wh/kg at a 4-h rate and 200 W/kg at 80% DOD. Both types have demonstrated stable cycle life of greater than 400 cycles, with 1000 cycle-life expectancy. Earlier FeS/sub 2/ cells suffered from an appreciable (0.1-0.25%/cycle) cell capacity decline rate, which has been eliminated by recent innovations. A new molten-salt electrolyte, LiCl-LiBr-KBr (m.p. 310°C), improved performance and allowed a lower cell operating temperature of 400°C, from 425-450°C for earlier cells. Cell design flexibility, along with the high conductivity electrolyte and high energy density electrodes, offers a broad range of capability. A bipolar design with U.P. FeS/sub 2/ electrodes is projected to provide specific energy of 200 Wh/kg and specific power up to 5 kW/kg. Preliminary tests with a new cell design for reduced materials costs showed that the Li-Al/U.P. FeS/sub 2/ couple was capable of high specific energy in a rod-electrode configuration.

18339 (AD-A—185919/8/XAB) Investigation of the rechargability of certain modified forms of MnO_2. Quarterly report No. 1. Appleby, A.J. (Ementeck, Inc., College Station, TX (USA)). 30 Sep 1987. 4p. NTIS, PC A02/MF A01.

The objective of this contract is to perform work on the development of a high-rate rechargeable zinc-manganese dioxide system based on Ford's technology and to examine the possibility of a rechargeable lithium organic electrolyte intercalation-type system using birnessite manganese dioxide(MnO_2) compounds. In addition, some studies on the structures of compounds will be carried out, as may be possible according to the technical means available, on the scientific reasons for the rechargeability of birnessite. Examples of scientific techniques that may throw light on this were quoted in the statement of work as Fourier Transform Infrared Spectroscopy (FTIR), X-ray diffraction and EXAFS.

18340 Corrosion resistant glasses for use in lithium ambient-temperature batteries. Watkins, R.D.; Bunker, B.C.; Douglas, S.C.; Brow, R.K.; Hellstrom, E.E. (Sandia National Labs., Albuquerque, NM). pp 1113-1118 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—).

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879398.

Calcium-boroaluminate (CABAL) glasses have been developed for use as sealing glasses in lithium ambient-temperature batteries. The results from numerous corrosion studies suggest that CABAL glasses have over an order-of-magnitude lower corrosion rates in Li/electrolyte environments relative to presently used silicate glasses, such as TA-23. Battery lifetimes, as determined by glass corrosion, are now being projected beyond 25 years under the most severe storage conditions. In addition, the header processing is improved relative to TA-23 because CABAL glasses require much lower temperatures for melting and sealing than the silicate predecessors. Seals have been evaluated for mechanical integrity and appear at least as strong as seals made with TA-23 glass.

18341 Improvements to the cycle-life performance of the Zn/KOH/NiOOH cell. Adler, T.C.; Mc Larnon, F.R.; Cairns, E.J. (Applied Science Div., Lawrence Berkeley Lab., Berkeley, CA 94720). pp 1097-1101 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—). Contract AC03-76SF00098.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879395.

A model Zn/NiOOH cell containing a 25 mol% Ca(OH)/ sub 2/ negative electrode and 15 wt% KOH-15 wt% KF electrolyte was subjected to a pulse-current charging regimen. Cycling at 100% depth-of-discharge, this cell achieved over 500 cycles at greater than 70% of its original capacity. Examinations of the negative electrode after cycling showed none of the hexagonal-shaped calcium zincate crystals observed on Ca-substituted electrodes cycled in 31-wt% KOH electrolyte. Other Ca-substituted electrodes were evaluated with alkaline-fluoride electrolyte employing both constant-current voltage-limited and pulse-current voltage-terminated charging regimens.

18342 Zinc/bromine battery development. Zagrodnik, J.P.; Eskra, M.D. (Johnson Controls, Inc., Milwaukee, WI). pp 1039-1044 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—).

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879264.

Johnson Controls INc. (JCI) has been developing the zinc/bromine battery system since it purchased the right to the Exxon technology in 1982. Recent efforts have concentrated on the design, assembly and testing of large (20 to 40 kWh) battery systems for electric vehicle and load-leveling applications. A 20-kWh electric vehicle battery, Z20-low profile, was assembled and tested as part of a contract sponsored by Sandia National Laboratories (SNL). Cycling included capacity tests, power tests, and standing self-discharge tests. A 20-kWh load-leveling module was also designed, assembled, and tested at the recently completed load management test facility at JCI. The data collected from this battery will be used to more fully understand the requirements for the zinc/bromine battery in a customer-side-of-the-meter load management application. Two 21-kWh battery systems were constructed and tested in a modified full size Dodge van. This was the first fully integrated demonstration of a zinc/bromine battery in a road worthy vehicle. The vehicle was equipped with full instrumentation to study the battery's characteristics under actual driving conditions. In December of 1986, JCI was awarded a cost-share contract sponsored by Sandia National Laboratories which involves the development and qualification of a proof-of-concept zinc/bromine electric vehicle battery system.

18343 Additives to increase the discharge capacity of the moving bed Zn/Air battery. Sierra Alcazar, H.B.; Nguyen, P.D. (Pinnacle Research Institute Inc., Cupertino, CA 95014). pp 1033-1038 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—).

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879397.

The capacity extension of additives was tested in a 200 cm/ sup 2/ bi-cell and a Zn powder moving-bed slurry. It was found that for the type A additives in 12 M KOH, silicate at 25 g/l as SiO/sub 2/, was better than stannate titanate and aluminate additives. The best concentration of sorbitol (a type B additive that stabilizes polymeric chains involving ZnO) was found to be 15 g/l in 12 M KOH. A silicate and sorbitol combination allowed 20% increase in capacity (195 Ah/l at 200 A/cm/sup 2/) with respect to single additive capacity extension. Very poor capacity extension was found for silicate as type C additive (precipitation of ZnO away form the Zn surface, for low KOH concentrations). Cell voltage and power densities were determined as a function of a) current densities, b) cathode depolarizer (air or oxygen), and c) type of slurry (Zn powder or Zn coated polymeric bead). The mechanisms of passivation and capacity extension are discussed and recommendations presented for further research and development.

18344 (AD-A—186044/4/XAB) D-C (direct current) conductivity studies of an hydroxide ion conductor at intermediate temperatures. Technical report. Crouch-Baker, S.; Huggins, R.A. (Stanford Univ., CA (USA). Dept. of Materials Science and Engineering). 30 Jul 1987. 4p. (TR—7). NTIS, PC A02/MF A01.

In this study, preliminary experiments are conducted on an hydroxide ion-conducting electrolyte, which may have potential for application to the electrolysis of steam at intermediate temperatures. In this work the DC conductivity of wet Li_5AlO_4 samples was measured as a function of temperatures and applied voltage. It is proposed that, under the conditions employed in this work, D-C charge conduction is due to the transport of hydroxide ions derived from the LiOH contained in the structure, rather than by electronic species.

18345 (AD-A—186345/5/XAB) Importance of electrode/ zirconia interface morphology in high-temperature solid-electrolyte cells. Technical report. Gur, T.M.; Huggins, R.A. (Stanford Univ., CA (USA). Dept. of Materials Science and Engineering). 1987. 9p. (TR—2). NTIS, PC A02/MF A01.

Pub. in Jnl. of Applied Electrochemistry, Vol. 17, 800-806(1987).

The role of electrode/electrolyte interface morphology in the overall polarization behavior of high-temperature solid-electrolyte cells was studied. Carefully prepared and polished scandia-stabilized zirconia discs with sputtered platinum electrodes were examined using electron-microscopy and electrical-polarization techniques. Initially, non-porous sputtered platinum electrodes were conditioned by a progressive treatment to generate artificial porosity. This eliminated subsequent time-dependent changes in the interface-related impedance of such cells. After prolonged use, the

anode and cathode morphologies were found to be distinctly different from each other.

18346 (CONF-871121—2) Sodium-sulfur technology evaluation at Argonne National Laboratory. Mulcahey, T.P.; Tummillo, A.F.; Hogrefe, R.L.; Christianson, C.C.; Biwer, R.; Webster, C.E.; Lee, J.; Miller, J.F.; Marr, J.J.; Smaga, J.A. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002852/JAW.

From 8. battery and electrochemical contractors' conference; Tyson Corner, VA, USA (16 Nov 1987).

The Analysis and Diagnostics Laboratory (ADL) at Argonne National Laboratory has completed evaluation of the Ford Aerospace and Communication Corp. (FACC) technology in the form of four load-levelling (LL) cells, five electric vehicle (EV) cells, and a sub-battery of 89 series connected EV cells. The ADL also has initiated evaluation of the Chloride Silent Power Limited (CSPL) sodium-sulfur (PB) battery technology in the form of 8 individual cells. The evaluation of the FACC-LL cells consisted of an abbreviated performance characterization followed by life-cycle tests on two individual cells and life-cycle tests only on the two other individual cells. The evaluation indicated that the technology was improving, but long-term (life) reliability was not yet adequate for utility applications. The cells exhibited individual cycle lives ranging from 659 to over 1366 cycles, which is equivalent to 2 1/2 to 5 1/2 years in utility use. It was also found that full-cell capacity could only be maintained by applying a special charge regime, regularly or periodically, that consisted of a constant-current followed by a constant-voltage.

18347 (LBL—23959) Polymeric electrolytes for ambient temperature lithium batteries: Final report. Farrington, G.C. (Pennsylvania Univ., Philadelphia (USA). Dept. of Materials Science and Engineering). Sep 1987. Contract AC03-76SF00098. 27p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004896/JAW.

During this reporting period a number of novel solid polymer electrolytes formed by salts of multivalent cations and poly(ethylene oxide) [PEO] have been prepared and characterized. These materials are of interest not only because of their potential ionic conductivities, but also because some of them may have electronic conductivity and oxidizing power which would be useful for novel electrode materials in all-solid-state batteries. Two broad classes of materials were investigated: PEO solutions of Zn(II), Cd(II), and Pb(II), all of which are potential electrolytes for solid-state batteries, and PEO solutions of transition metal salts, which are of interest as possible cathode materials. Mixed compositions containing both divalent cations and lithium ions were also prepared. Electrolytes formed with small, highly-polarizing ions, such as Mg(II) and Ca(II), are essentially pure anion conductors. Electrolytes containing Zn(II) behave similarly, unless they are hydrated, in which case the Zn(II) ions are quite mobile. Electrolytes formed with larger, more polarizable cations, such as Pb(II) and Cd(II), conduct both anions and cations. Solutions of salts of transition metal cations form a third group of electrolytes. Of the electrolytes investigated so far, those formed with Ni(II) salts are the most unusual. It appears as if the transport number of Ni^{++} and the electrolyte conductivity can be greatly enhanced by controlling the hydration and dehydration of the polymer. 10 refs., 9 figs., 1 tab.

18348 (LBL—24177) Corrosion, passivity and breakdown of alloys used in high energy density batteries: Final report. Kruger, J. (Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Materials Science and Engineering). Oct 1987. Contract AC03-76SF00098. 25p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004891/JAW.

The objective of this research is to further the understanding of the passivity of metals and alloys in non-aqueous and mixed solvents. There is a lack of data in this area, despite its importance to applications such as the construction materials for high energy density batteries. There have been a number of corrosion-related problems reported in the construction materials of such batteries. As demands for longevity for these batteries increase, problems associated with corrosion will become increasingly important. This work is concerned with analyzing the nature, mode of formation, and mode of breakdown of passive films that exist on alloys in non-aqueous and mixed solvents. Work during Year I has concentrated upon generating cyclic voltammograms and potentiodynamic curves as baseline data on Au and Armco Fe in water/propylene carbonate mixtures. In addition, Scanning Electron Microscopy has been performed in order to characterize the attack observed and to correlate it to the electrochemical parameters measured. 3 refs., 15 figs.

18349 (LBL—24181) A new concept in an electrically rechargeable zinc-air alkaline battery. Ross, P.N. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 9p. (CONF-871121—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003858/JAW.

From 8. battery and electrochemical contractors' conference; Tyson Corner, VA, USA (16 Nov 1987).

This paper describes a new idea for zinc-air battery design. The novel idea is a porous zinc electrode surrounded with a supersaturated zincate solution. 3 figs. (JDH)

18350 (PB—88-129291/XAB) Calcium and zinc high-temperature batteries using intercalation cathodes. Final report, 1 February-31 August 1985. Sammells, A.F.; Schumacher, B. (Eltron Research, Inc., Aurora, IL (USA)). Aug 1985. 70p. NTIS, PC A04/MF A01.

This research effort was directed toward generating the scientific understanding necessary for evaluating the viability of Ca^{2+} and Zn^{2+} conducting B'-alumina solid electrolytes for a new type of advanced battery system using either calcium, calcium-silicon alloys, or zinc as the anode material with ionic mediation to the divalent conducting solid electrolyte being via the presence of an appropriate molten salt. The cathode used in these cells was a solid-state intercalation material consisting of immobile transition metal redox species incorporated in a B'-alumina type lattice. Excellent electrochemical reversibility was found for both calcium silicon alloys in binary calcium halide molten salts, and the proposed solid-state cathode materials.

18351 (NP—8770046, pp 451-453) Research and development of peripheral technology of photovoltaic power generation. Research and development of electricity storing apparatus for photovoltaic power generation (closed-style). Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

A research was made for the development of a cathodic absorption type closed-style lead battery to be used in combination with solar cells and the following results and knowledge were obtained; 1) Improvement of the performance of positive and negative electrode plates; A battery with low density of active material has a very short life. The electrode plate construction which excels at the low self-discharging rate, the anti-overcharging performance and the anti-overdischarging performance was revealed. 2) Research of electrode plates grouping; The proper specific gravity of the electrolyte liquid, the kind and amount of the additive to the electrolyte liquid and the treatment of the separator, etc. give big effects on the initial descharging performance. 3) Research of battery composition; The construction of the cover to make grouped batteries compact was elucidated and sealing material and long-life safety valves were selected. Concerning a compact unit of the combination of solar cells and the battery, 40% reduction of the unit volume became feasible. (1 fig)

18352 (NP—8770046, pp 454-459) Research and development of peripheral technology of photovoltaic power generation. Research and development of electricity storing apparatus for photovoltaic power generation (open style). Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

A research was made for the development of an open-style lead battery for the photovoltaic power generating system and the following results and knowledge were obtained; 1) Research of improving the performance of grouped electrode plates; Concerning stratification of the electrolyte liquid and distribution of the amount of $PbSO_4$ in the electrode plate, there is almost no difference due to the different composition of the plate alloy. As the interval between

the electrode plates becomes wider, the preventative effect of stratification of the electrolyte liquid becomes better. As the specific gravity of the electrolyte liquid becomes smaller and the volume of the liquid becomes larger, the difference of the specific gravity of the electrolyte liquid becomes smaller. Furthermore as the difference of the specific gravity becomes larger, the decline of the voltage at the end of discharge becomes larger. 2) Research of unitization; Of the size of around 500-600 Ah per cell, the cost of cell per Ah becomes the lowest. The capacity needed for the stand-alone photovoltaic power generating system can be obtained by combining the unit for mass production of this size properly. (3 fig)

29 ENERGY PLANNING AND POLICY

18353 (NP—8770044, pp 7-13) **Outline of Ensham Project.** Hayashi, Jiro. (Idemitsu Oil Co. Ltd., Tokyo, Japan). 21 Sep 1984. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

In Proceedings of parallel sessions for the 4th NEDO general assembly.

This is a project funded by NEDO. State Government of Queensland, Australia, assigned a right to a consortium composed of 7 companies including Idemitsu Kosan K.K. and Australian enterprises in search for coal in the Bowen Coal Basin. The Bowen Coal Mines is situated at 350 km to the west of the Gladstone Harbor with a mining area of approximately 1230 km^2. Its main coal seam is regarded as formed in the Permian Period. Its geological structure is an inclined one in the direction of NNW - SSE and the central area is distributed with a precipitate of the Triassic Period. Topographically the land is flat abobe 150 - 190 m of the sea level and is used mainly for farming and cattle breeding. At 35 km west of the coal mine, a town called the Emarald with population of 8,000 is situated, and at 45 km to the east, the Black Water of the similar size. Harbors at Gladstone and Hay Point will be used for the shipment of coal. The Central Queensland Railroad passes across the south of the mine area. (3 figs, 1 tab)

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 18385, 18418, 18480

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 17708, 17722, 17911, 17974, 17978, 18045, 18067, 18092, 18368, 18384, 18388, 18424, 19666

18354 **(DOE/EIA—0466(86)) Profiles of foreign direct investment in US energy, 1986.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 23 Dec 1987. 43p. NTIS, PC A03/MF A01 - GPO; 1; GPO Dep. Order Number DE88004324/JAW.

In accordance with the Department of Energy Organization Act, the Energy Information Administration (EIA) prepares an annual report for the Secretary of Energy and for transmittal to Congress. This report summarizes the activities in the United States by foreign-affiliated companies that own or control US energy sources and supplies. Presented in this 1986 report are profiles of foreign direct investment in US petroleum (including natural gas production); foreign-affiliated companies' energy production, processing, distribution, and reserves; and foreign-affiliated energy companies' financial performance and investment activity in 1986. Additionally, profiles of US companies' energy operations abroad and comparisons of foreign-affiliated companies to US energy companies are presented. The information is intended for use by the Congress, Government agencies, energy industry analysts, international trade and finance analysts, and the public. 13 refs., 4 figs., 21 tabs.

18355 **(NYSERDA—87-15) Investigation into the establishment of a corporation for energy financing: Final report.** (Lane and Edson, P.C., Washington, DC (USA)). Aug 1987. 124p. NYSERDA, Two Rockefeller Plaza, Albany, NY 12223. Order Number TI88900282/JAW.

Performance contracting addresses one of the most significant barriers to energy projects, which historically has been the lack of funding. However, there are barriers to the use of performance contracting in New York. Lack of information on the part of building managers and financial institutions, a need for ongoing, intensive assistance by governments, complex procurement procedures and regulations, and the number of small projects with high transaction costs are all reasons why performance contracting has not been used to a greater extent in New York and elsewhere. Seven subsectors have been identified within the public and publicly assisted building sector. They include elementary and secondary schools, universities colleges, municipal governments, hospitals, public care facilities, state office buildings and public housing. The total potential investment for energy efficiency projects in these subsectors is approximately $2 billion. In its initial years of operation, OEF should target universities, colleges and State-owned facilities, because projects in these subsectors are likely to be larger, easier to implement and will enable the State to test the need for the creation of the Corporation for Energy Financing. In examining institutional structures capable of offering the services described above, it was determined that most of the services could be provided through a pilot program at the Energy Authority, in coordination with other state agencies such as the State Energy Office.

18356 **(PNL-SA—15292) Energy implications of structural change in the US economy.** Roop, J.M. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 16p. (CONF-8710250—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003427/JAW.

From IEA energy demand analysis symposium; Paris, France (12 Oct 1987).

This paper examines the implications of structural change on industrial sector energy consumption in the US economy over the period 1972-1982. Structural change is identified by changes in the input-output structure of the economy at three points in time: 1972, 1977 and 1982. The industrial sector is defined as the goods producing sectors of the economy - agriculture, mining, construction and manufacturing. Energy consumption is derived from the National Energy Accounts that provide details of energy use by fuel type for 89 industrial sector industries. The paper is organized into five sections. The first provides background on changes in the US economy and discusses the principal actors that are instrumental in structural change. This first section provides a framework for discussion of the methods used in the analysis, which is the topic of the second section. Application of this method to US data is the topic of the third section. A fourth section summarizes the results of the empirical work and draws some of the more obvious conclusions from the results. References are in the final section. 7 refs., 5 figs., 1 tab.

18357 **(SOL—88-1) On the role of complete reducibility in general competitive equilibrium models.** Krenzin, K.T. (Stanford Univ., CA (USA). Systems Optimization Lab.). Jan 1988. Contract FG03-87ER25028. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005693/JAW.

In this report a class of economic models is defined which properly includes most of the popular forms used in general equilibrium modelling. For these models, conditions are derived which are sufficient to insure the existence of an equilibrium in positive prices, fulfilling the natural expectation that a model is defined over economically relevant entities. The conditions are somewhat weaker than those historically imposed, and represent, for the most part, a combinatorial restriction of the data describing the model. As such, the large part of the conditions can be tested by a strongly polynomial algorithm presented herein. Moreover, there are derived necessary conditions which are apparently only slight relaxations of those sufficient conditions. 17 refs.

18358 **(SOL—88-2) Strongly polynomial calculations of general competitive equilibria in pure trade, Cobb-Douglass economies.** Krenzin, K.T. (Stanford Univ., CA (USA). Systems Optimization Lab.). Jan 1988. Contract FG03-87ER25028. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005694/JAW.

This report addresses the general equilibrium problem, existence and calculation, in a model of a pure trade economy where every trader's behavior is modelled as an optimization problem with a linear budget constraint and a Cobb-Douglas utility function.

This will extend the work of Eaves and Afriat who considered the same model with simplifying assumptions. Necessary and sufficient conditions are presented for the existence of an equilibrium without further assumptions about the economy, the matter of uniqueness (and lack of it) is completely understood, efficient (i.e., strongly polynomial) algorithms are presented for the calculation of a representative equilibrium and, where uniqueness fails, inefficient (i.e., exponential, but finite) algorithms are presented to characterize the entire set of equilibria, where possible, with a discussion of the inherent exponential nature of this calculation. 5 refs.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 17409, 17410, 17412, 17634, 17635, 17662, 17711, 17716, 17750, 17774, 17802, 17804, 17840, 17912, 18194, 18282, 18296, 18362, 18381, 19110, 19204, 19240, 19241, 19297, 19298, 19299, 19300, 19301, 19302, 19303, 19304, 19305, 19344, 19350, 19351, 19352, 19353, 19354, 19355, 19356, 19357, 19358, 19359, 19362, 19363, 19556, 20531

18359 **(IIUG/dp—86-4) Environmental policy in Britain. Reaffirmation or reform?.** Macrory, R. (Wissenschaftszentrum Berlin (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft; Imperial Coll. of Science and Technology, London (UK)). 1986. 51p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751950/JAW.

Britain's geographical characteristics and common law traditions have given rise to environmental laws and policies which display particular national characteristics, notably a gradualist and decentralized approach. Very real achievements in many areas of environmental control over the past 100 years have, however, resulted in a degree of administrative complacency, and an exaggerated support for the status quo in policy discussions, particularly at an international level. The changing shape of national politics together with Britain's apparent isolated position in the international community on a number of environmental issues have combined together to give rise to pressures for radical rethinking in administrative circles on the efficacy of long-established practices. Key policy shifts that have already taken place, notably relating to agriculture, are considered, and it is suggested that there will be an increasing move towards centralism in policy design. The results of current developments may well give rise to important changes in legislative and administrative approaches, that have hitherto been seen as an essential feature of British environmental policy.

18360 **(PB—88-125257/XAB) Recent advances in hazardous materials transportation research: an international exchange. State-of-the-art Report 3, addendum.** Hills, P.; Geysen, W.J.; Tomachevsky, E.G.; Ringot, C.; Pages, P. (National Research Council, Washington, DC (USA). Transportation Research Board). 1986. 40p. (TRB/TRR/SOAR—3-ADD). NTIS, PC A03/MF A01.

Library of Congress catalog card No. 86-18145.

The 4 papers in the report deal with the following areas: the transport of non-nuclear toxic and dangerous wastes in the United Kingdom; the transport system of dangerous products as a risk factor for the future: the computer-aided information program on hazardous materials; a validation study of the INTERTRAN model for assessing risks of transportation accidents: road transport of uranium hexafluoride; modifying the regulation for small radioactive package transit through the Mont Blanc tunnel-assessment of the health and economic impact.

18361 **(PB—88-131750/XAB) National toxicology program: review of current DHHS (Department of Health and Human Services), DOE (Department of Energy), and EPA (Environmental Protection Agency) research related to toxicology, fiscal year 1987.** (National Toxicology Program, Research Triangle Park, NC (USA)). Aug 1987. 366p. (NTP—87-002). NTIS, PC A16/MF A01.

See also PB—88-131743, and PB—84-128651.

Five of the six Public Health Service agencies support research related to toxicology. Within the National Institutes of Health (NIH) alone, twelve separate institutes and several other components support relevant research. Toxicology-related research is also conducted by other Federal agencies -- particularly the Department of Energy (DOE) and the Environmental Protection Agency (EPA). The review covers projections for Fiscal Year 1987, made by September, 1986 and based on the President's proposed budget. It represents responses by agencies of DHHS, and by DOE and EPA, to requests by the Director of NTP for information on agency programs in basic toxicology research, toxicology testing, and toxicology methods development.

2904 Natural Resources

REFER ALSO TO CITATION(S) 17909, 19113, 19297, 19298, 19299, 19300, 19303, 19357, 19674

18362 **(PB—88-131248/XAB) Opportunities to protect instream flows and wetland uses of water in New Hampshire and Connecticut.** Carney, L.D.; Michael, C.L.; Gould, G.A.; Ausness, R. (Denver Univ., CO (USA). Coll. of Law; McGeorge School of Law, Sacramento, CA (USA); Kentucky Univ., Lexington (USA)). Aug 1987. 106p. NTIS, PC A06/MF A01.

The publication is one of a series of similar documents for western and midwestern States that provides a survey of State prerogatives and programs that may be used to protect the instream uses of water. Most of the opportunities for protecting instream flows are related to fish and wildlife habitat, although many other instream uses are considered, including hydroelectric power production, recreation, nagivation, downstream delivery, and wasteload assimilation. The documents illustrate methods to protect instream uses within the context of existing laws and regulations.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 17405, 17419, 17420, 17421, 17422, 17423, 17424, 17425, 17467, 17468, 17469, 17470, 17472, 17475, 17478, 17479, 17480, 17481, 17482, 17487, 17526, 17689, 17906, 17915, 17923, 18035, 18042, 18047, 18111, 18342, 18355, 18419, 18420, 18426, 18462, 18481, 18483, 18526, 18919, 18931, 19103, 19674, 20006

18363 **(LA—10949-PR) Los Alamos National Laboratory technology transfer report, FY86: Progress report.** Sadler, M.A.; Tellier, N.A.; Freese, K.B. (Los Alamos National Lab., NM (USA)). Dec 1987. Contract W-7405-ENG-36. 25p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005102/JAW.

The Office for Industrial and International Initiatives serves as the initial point of contact for companies wishing access to the Laboratory's technology resources. The Office assists both industry and Laboratory personnel in the transfer process. Methods used to share technology include publications, site visits, meetings and conferences, exchange of personnel, collaborative research, and industrially sponsored research. The Laboratory's Technology Transfer Program provides technology and technical assistance to domestic private industry, universities, schools, and State and local governments. These interactions have grown steadily over the past few years, primarily because of changes in federal policy and legislation that encourage such collaboration. This trend is expected to continue as US industries turn increasingly to technological innovation to improve their productivity and competitiveness in a global economy.

18364 (NP—8770046, pp 1064-1067) **Results of studies related to new energy in 1985.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is a report on the results of NEDO's studies made in 1985 in relation to subsitute energies for petroleum. This annual report contains 31 study reports concerning coal energy technology (2), solar energy technology (2), geothermal energy technology (3), fuels and storage technology (2), alcohol/biomass technology (1), resource development of terrestrial heat and coal (5), trend of development, investigation on conciousness and actual state, etc. about new energies (8), and new energy situation and others in major overseas countries (8).

18365 **(PB—88-100011/XAB) Directory of Federal laboratory and technology resources, 1988-1989: a guide to services, facilities, and expertise.** (National Technical Information Service, Springfield, VA (USA). Center for the Utilization of Federal Technology). Jan 1988. 337p. NTIS PC$36.00.

Supersedes PB—86-100013.

This directory provides convenient access to hundreds of Federal agencies, laboratories, and engineering centers willing to share their expertise, equipment, and sometimes their facilities. Detailed summaries of more than 900 unique resources are arranged within 31 subject oriented areas for easy reference. The name, address, and phone number of a personal contact are listed for each entry along with the descriptive summary. Subject, state, resource and organization name, and agency indexes make it easy to locate the necessary resources. Also included are complete descriptions of the more than 90 U. S. Government technical information centers. These centers offer information services and expertise in areas such as fuels, cold regions, concrete, fisheries, toxicology, pesticides, plus many others. This directory offers a convenient Government-wide reference tool that an engineer, scientist, or decision maker can use to locate resources selected for their ability to offer technological assistance. Also included in this edition is a complete listing of all Federal laboratory technology-transfer offices. Addresses and telephone numbers are provided.

18366 **(PB—88-128186/XAB) Resident research associateships. Post-doctoral and senior research awards, 1988. Opportunities for research at the National Institute for Occupational Safety and Health.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 1988. 39p. NTIS, PC A03/MF A01.

See also N—85-14717.

A national competition conducted by the National Research Council to recommend and make awards to outstanding scientists and engineers was described. Under the program, recent postdoctoral and experienced senior level researchers compete for tenure as guest researchers at participating NIOSH laboratories. It is anticipated that about 1,000 applications will be received for the nearly 300 new awards to be made in the 1988 program year. The mechanics of operation of the award decision-making process were reviewed. Opportunities for research were presented in the fields of bioengineering, biological monitoring, cell physiology and biochemistry, epidemiology, immunology, microbiology and mutagenesis, noise, pathology, pharmacology, physiology and biophysics, radiofrequency radiation, stress and human factors, toxicology, and vibration. An index includes research advisers and administrative personnel in the divisions of biomedical and behavioral science, respiratory disease studies, and centers for disease control. Parent organizations that participate in the Resident Research Associateship Programs are listed along with their requirements for acceptance and the application deadlines.

18367 **(TNDC—8900379) List of scientific and technical literature relating to Thailand: No. 8.** Setisarn Y.; Klomjai, S. (comps.). (Thailand Inst. of Scientific and Technological Research, Bangkok. Thai National Documentation Centre). 1985. 134p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88900379/JAW.

Books, periodical articles, papers from conference proceedings, theses and technical reports in science and technology which provide information on Thailand are cited. The coverage of this series which is intended to be as exthaustive as possible has been extended to include topics in socio-economic aspects of industry. The items are arranged under broad subject headings corresponding to those of the Universal Decimal Classification (UDC) system. Bibliographical citations follow International Organization for Standardization (ISO) recommendation for bibliographical references. A detailed subject index is added for convenience in locating specialized topics. For more complete information, readers are suggested to consult other TNDC publications, namely Abstracts of TISTR Technical Reports, Thai Abstracts, Abstracts of Master Theses in Thailand 1944-1977 and Index to Master Theses in Thailand 1975-1979.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 17702, 17750, 17776, 17840, 17845, 18194, 18205, 18206, 18207, 18208, 18360, 19344, 19562, 20013

18368 **(CONF-8711119—1) The role of state regulatory commissions in utility integrated resource planning.** Hirst, E. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003990/JAW.

From National Association of Regualtory Utility Commissioners meeting; New Orleans, LA, USA (16 Nov 1987).

Integrated resource planning is important for electric utilities and their state regulatory commissions. Although much has been written about the obligations of the utilities, little has been published concerning the roles and responsibilities of public utility commissions. This paper discusses several issues that merit further consideration: (1) protection of utility from prudency reviews associated with decisions to construct resources included in approved plans; (2) definition of the appropriate economic test(s) to be used in assessing demand-side programs; (3) review of alternative treatments of utility conservation-program costs (e.g., capitalizing vs expensing); (4) inclusion of marketing efforts, economic development, and competition in the integrated planning process; (5) treatment of uncertainty about the performance of resources and the utility's external environment; (6) consideration of environmental, social, and political factors related to different resources; and (7) development of appropriate staffing and funding levels needed by commissions to properly review utility plans. This paper seeks to stimulate discussion about structuring regulation to encourage (rather than require) utilities to develop integrated planning processes and plans. Better planning is likely to reduce energy-service costs for customers, increase flexibility for utilities and commissions, and decrease controversies over future resource acquisition. 27 refs., 1 fig., 2 tabs.

18369 **(DOE/IE/10509—T1) Comments related to the proposed new civil nuclear agreement for cooperation between the United States and Japan.** (International Energy Associates Ltd., Fairfax, VA (USA)). 29 Jan 1988. Contract AC01-86IE10509. 117p. (ERCI-R—88-12). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005303/JAW.

This paper is designed to respond to several major comments or concerns that have been expressed about the proposed new Civil Nuclear Agreement for Cooperation with Japan which is now undergoing review by the Congress. It is supplementary to presentations that the Executive Branch already has made in support of the Agreement and is designed to be a tool for use by those who are still in the process of reviewing the Agreement and forming their views as to its implications. This document is comprised of three parts. (A) Executive Summary that reviews and attempts to answer in high-light form several of the major questions that have been raised about the agreement. (B) A detailed discussion of several of these points for the reader who wishes to go into these subjects in more depth. (C) An analysis designed to illustrate the major ways in which the proposed new Agreement with Japan is more rigorous from a non-proliferation standpoint than the current Agreement for Cooperation which has been in force in its current form since 1968.

18370 **(EDF-DER-RA—1986-2) DER 86: main facts.** (Electricite de France, 75 - Paris). 1987. 145p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE87753184/JAW.

This report presents the important facts among the studies carried out by the Direction des Etudes et Recherches (E.D.F.): new applications of electric power for customers, protection of environment, classical equipments for power plants and nuclear equipments, monitoring and control of power plants, electrical equipments, development and operation of electrical networks, informatics and office automation.

18371 **(FRADOC—10-1) Industrial aspects of nuclear energy.** Leny, J.C. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Jun 1986. 11p. (In French). (CONF-860603—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751874/JAW.

From 4. European nuclear conference and 9. FORATOM congress (ENC '86) and international nuclear trade fair; Geneva, Switzerland (1 Jun 1986).

Published in summary form only.

18372 **(IAN—1985) Progress report 1985.** (Instituto de Asuntos Nucleares, Bogota (Colombia)). 1986. 56p. (In Spanish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702737/JAW.

The document informs about the activities made by the Institute of Nuclear Affairs (Colombia) during 1985.

18373 **(IAN—1986) Progress report 1986.** (Instituto de Asuntos Nucleares, Bogota (Colombia)). Feb 1987. 56p. (In Spanish). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702738/JAW.

The document informs about the activities made by the Institute of Nuclear Affairs (Colombia) during 1986.

18374 **(INIS-mf—11106) Annual report 1986-1987 (of the Department of Atomic Energy, Government of India).** (Department of Atomic Energy, Bombay (India)). 1987. 88p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88701317/JAW.

The activities of the various constituent units of the Department of Atomic Energy (DAE) (India) during the fiscal year 1986-1987 are reported. The main thrust of the DAE's various activities is directed towards peaceful applications of nuclear energy - for generation of electric power in particular and for applications of radioisotopes and radiations in agriculture, medicine and industry in general. The various constituent units of DAE consist of research establishments, nuclear power plants, heavy water plants, nuclear fuel fabrication and reprocessing plants, industrial undertakings in public sector field which manufacture electronic equipment, and rare earth products from beach sands, uranium mines and uranium ore processing plants, regulatory and safety bodies and survey unit for exploration of atomic minerals. In addition DAE also fully funds the research programmes of the Institute of Physics at Bhubaneswar, the Saha Institute of Nuclear Physics at Calcutta, the Tata Institute of Fundamental Research and the Tata Memorial Centre both at Bombay. The report is presented in chapters entitled: (1) general survey, (2) nuclear power, (3) research and development, (4) regulatory and safety functions, (5) public sector undertakings, and (6) other activities such as international relations in the field of nuclear science and technology, financial assistance to research organization and universities, sponsoring of conferences, symposia, workshops etc. The work on three nuclear power plants at Narora, Kakrapar and Kaiga and two heavy water plants at Manuguru and Hazira is in various stages of construction.

18375 **(INIS-XN—88) 1986 Agreement on third party liability in the nuclear field.** (International Atomic Energy Agency, Vienna (Austria)). 22 Oct 1986. 3p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701323/JAW.

English translation attached.

This Agreement intends to facilitate the settlement of disputes, if they are due to an event (caused by the peaceful utilisation of nuclear energy) which occurs on the territory of one State and gives rise to damage on the territory of the other State. Unlike the Federal Republic of Germany, Switzerland has neither ratified the Paris Convention of 29th July 1960 on Third Party Liability in the Field of Nuclear Energy nor the Brussels Supplementary Convention of 31st January 1963. This might result in diverging interpretations by the German and Swiss courts, in particular, regarding the competent courts and the laws applicable if a third party liability problem were to arise between both countries. The Agreement therefore aims to settle these matters directly by treaty between the States before the courts are confronted by an occurrence of damage and have to seek a solution which conforms to international private law. (NEA).

2907 Transport And Storage

REFER ALSO TO CITATION(S) 18325, 18369

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 18498

18376 **(PB—88-130406/XAB) Pre-feasibility study on small-scale cogeneration plants. Research note.** ElMahgary, Y.; Sipilae, K.; Pihala, H. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Saehkoetekniikan Lab.). 1987. 56p. (VTT/RN—718). NTIS, PC E04/MF A01.

The technical aspects of small-scale cogeneration plants were outlined. The parameters affecting their economy were discussed. The economics of both SCP (Small Cogeneration Plants 1...20 MW(e) and MCP (Mini Cogeneration Plants < 1 MW(e)) was estimated using tariffs and costs valid in Finland. Two typical case studies were also considered. The result has demonstrated that both (SCP) Small Cogeneration Plants (1-20 MW(e)) and (MCP) Mini Cogeneration Plants (less than 1 MW(e))are generally competitive in comparison to other conventional methods of producing electricity and heat. In the case of SCP, the electricity tariff in force is the factor which has the most pronounced role in their economics. This is also true in the case of MCP; however, the district heat tariff and the type of fuel used in the boiler have similar pronounced effects in the case of MCP. Upon escalation of oil prices, the competitiveness of SCP & MCP using natural gas improves.

2910 Conservation

REFER ALSO TO CITATION(S) 18420, 18424, 18426, 18467, 18472, 18473, 18483, 18530

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 17656, 17697, 17721, 18032, 18067, 18356, 18385, 18388, 18469

18377 **(DOE/EIA—0035(87/08)) Monthly energy review, August 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 25 Nov 1987. 137p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. Order Number DE88002598/JAW.

The United States produced 1.0% less energy during the first 8 months of 1987 than during the same period in 1986, but US consumption was up 0.8%, compared with levels during the first 8 months of 1986. Energy production during August 1987 totaled 5.4 quadrillion Btu, a 2.0% increase compared with the level of production during August 1986. Coal production was up 4.9% and natural gas production increased 2.3%, while petroleum production decreased 1.0%. All other forms of energy production combined were up 2.2% from the level of production during August 1986. Energy consumption during August 1987 totaled 6.2 quadrillion Btu, 3.8% above the level of consumption during August 1986. Coal consumption increased 13.6%, and natural gas consumption rose 4.7%, while petroleum consumption decreased 1.8%.

18378 **(DOE/EIA—0035(87/09)) Monthly energy review, September 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 21 Dec 1987. 139p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. Order Number DE88004124/JAW.

Through the third quarter of 1987, the domestic energy industry continued to feel the effects of the 1986 oil price plunge. Although oil prices were up noticeably from 1986 prices, they remained well below prices recorded in the first half of the 1980's. US energy production for the first three quarters of 1987 fell to 48 quadrillion Btu, down 0.5% from the level of production during the same period of 1986. Energy consumption totaled 56 quadrillion Btu, up 1%, and a 12% increase in net imports-to-over 8 quadrillion Btu - was required to meet demand. The low price of oil tended to depress domestic oil production, which fell to 15 quadril-

lion Btu in the first three quarters of 1987, down almost 5% from production in the same period of 1986. Although Alaskan production reached a record high, due to increased production from recently completed projects, production in the lower 48 States declined. 43 figs., 54 tabs.

18379 **(DOE/EIA—0035(87/10)) Monthly energy review, October 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). 26 Jan 1988. 139p. NTIS, PC A07/MF A01 - GPO; 1; GPO Dep. Order Number DE88005311/JAW.

The United States produced 0.2% less energy during the first 10 months of 1987 than during the same period in 1986, but US consumption was up 1.3%. Net imports of all energy were 12.8% higher, with net imports of petroleum up 7.3%, compared with levels during the first 10 months of 1986. Energy production during October 1987 totaled 5.5 quadrillion Btu, a 2.5% increase compared with the level of production during October 1986. Coal production was up 7.3% and natural gas production increased 3.1%, while petroleum production decreased 0.4%. All other forms of energy production combined were down 4.6% from the level of production during October 1986. This issue contains a review of the potential oil production from the Arctic National Wildlife Refuge.

18380 **(DOE/PE/77029—H1) The projected impact of lower oil prices on US energy conservation.** (Applied Energy Services, Inc., Arlington, VA (USA); Energy and Environmental Analysis, Inc., Arlington, VA (USA)). Jan 1988. Contract AC01-85PE77029. 38p. NTIS, PC A03/MFA 01; 1; GPO Dep. Order Number DE88005887/JAW.

In view of conservation savings during a period of rising world oil prices (1972 to 1982), the dramatic drop in world oil prices in 1986 elicits the question: Do low world oil prices threaten the conservation savings that occurred during the previous decade? In order to test the potential loss in conservation from the drop in world oil prices in the target year 1995, two oil price scenarios were constructed: a case testing what would have occurred if oil prices remained at their 1984 level ($30/barrel in 1985 dollars), and one in which prices drop to and are maintained at $14/barrel (in 1985 dollars). This approach represents a boundary analysis, illustrating what could happen to conservation rather than predicting what will happen. By comparing projections of energy consumption under the two scenarios, the potential conservation loss from the drop in oil prices can be estimated: (1) potential conservation losses from lower world oil prices might be in the range of 9% in 1995; (2) only about one quarter of this conservation loss represents potential losses in energy efficiency; and (3) the remaining three quarters of the conservation losses result from behavioral changes and increased economic growth under lower prices. The answer to the question posed above is therefore yes; low oil prices do pose a threat to the conservation savings amassed during the past decade. But the threat is not as great as it could be 1-10% loss versus a 25% previous gain). This is because only a small part of the efficiency gains (about 2.5% out of 17%) would be lost. Most of the projected losses in conservation from low oil prices would be behavioral losses (almost all of the 8% past behavioral gain could be lost). 14 figs., 9 tabs.

18381 **(ORNL—6257) Emergency food delivery: A state-of-the-art assessment: Final report.** Bjornstad, D.J.; Baxter, F.P.; Gutmanis, I. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 123p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88003685/JAW.

The purpose of this report is to provide a critical literature review of the state of the art in emergency food supply issues, to relate these issues and literature to the mission of the Federal Emergency Management Agency (FEMA) and to recommend areas where improved information and documents would allow FEMA to more effectively perform its mission. Major topics include the institutions which participate in emergency food delivery; the factual dimensions of US agriculture as they relate to emergency food delivery; short-term emergency feeding issues; and long-term emergency feeding issues. Several recommendations are developed. FEMA should develop a more detailed working relationship with the Department of Agriculture (USDA). FEMA should prepare documentation of its own emergency feeding procedures and guidelines. FEMA should test some previously developed options, particularly the preattack food relocation program. FEMA should evaluate several past studies to determine their current relevance, particularly those carried out in the 1960s whose conclusions rest upon the technology of the agricultural and food processing sectors, FEMA should undertake several new studies, particularly regarding new developments in the international food market. 265 refs., 1 fig., 9 tabs.

18382 **Future demand for fuel and electricity.** Reister, D.B. (Oak Ridge National Laboratory, TN (USA)). *Resources and Energy;* **9**: No. 2, 121-140(Aug 1987).

A simple energy demand model for the United States has been developed. In the model, goods and services are produced using three factors: fuel, electricity, and capital-labor. Fuel and electricity are not perfect substitutes. The tradeoff between fuel and electricity is simulated by using a production function to produce energy from inputs of fuel and electricity. Energy conservation, the tradeoff between energy and capital-labor, is simulated by using a production function to produce goods and services from inputs of energy and capital-labor. The model has four parameters and a lifetime for capital stock. The parameters were estimated using data from 1960 to 1982 for values for the lifetime ranging from four years to 30 years. The errors are small when the lifetime is greater than 14 years. Energy demand forecasts were made for two sets of fuel prices: high and low. For the high fuel prices case, the model forecasts a steady decline in the demand for fuel. For the low fuel price case, the demand for fuel declines and then rises; by 2010, the demand for fuel is slightly larger than the demand in 1979. For both sets of fuel prices the demand for electricity grows substantially. 10 refs., 9 figs.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 17716, 17750, 17802, 17804, 18302, 18418, 19240, 19241

18383 **(DOE/PE/76030—T3) China and the changing global energy industry.** Fridley, D.; Fesharaki, F. (East-West Center, Honolulu, HI (USA). Resource Systems Inst.). Aug 1987. Contract FG01-84PE76030. 21p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005824/JAW.

China is not alone in the world in facing a potentially serious energy problem. All countries at some point in the future will need to deal with the prospects of an OPEC-dominated oil market, the environmental problems of widespread coal use, fears over the safety of nuclear energy, security of supply, and the maintenance of economic well-being in the face of higher energy prices. The world has already seen the potential for economic disruption and dislocation from rapid increases (or decreases) in energy prices, and concerns over supply disruptions have led to an unprecedented stockpiling of oil in OECD and other countries to provide a cushion if any future cut-offs occur. China, unfortunately, has little margin of security to deal with volatile energy prices or disruptions in supply; economic growth there has strained the energy system to the maximum, and already an estimated 20% of potential industrial output is lost owing to a shortage of electricity. With 7 years of an ambitious modernization program behind them, most Chinese have come to expect a higher standard of living in the years to come, but to achieve this goal, China must solve the pressing need to supply the additional energy to fuel future growth. Failure in this respect could lead to economic, and perhaps political, instability, with consequences spilling over to China's neighbors, trading partners, and allies. The magnitude of the problem cannot be ignored, but if cooperation and trade among these nations can be maintained, providing China with an outlet for its goods and a means to import needed technology and capital, then successful energy development can become a reality.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 17405, 17526, 17656, 17662, 17666, 17667, 17668, 17674, 17674, 17690, 17691, 17697, 17698, 17699, 17700, 17701, 17702, 17703, 17704, 17705, 17706, 17707, 17708, 17708, 17711, 17713, 17713, 17721, 17722, 17730, 18045, 18377, 18378, 18379, 18469, 18470

18384 (CONF-8605117—) Search for a bridge to the energy future: Proceedings. Saluja, S.S. (ed.). (North Dakota Univ., Grand Forks (USA). School of Engineering and Mines). 1986. Contract FG01-86FE61068. 202p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88004584/JAW.

From International conference on the development of alternative energy sources and the lessons learned since the oil embargo; Grand Forks, ND, USA (23 May 1986).

The alarming effects, concerns, and even the insights into long-range energy planning that grew out of the OPEC oil embargo of 1973 are fading from the view of a shortsighted public. The enthusiastic initiatives taken in many countries for the development of alternative energy sources have withered due to lack of economic and/or ideological incentive. The events since December 1985, when the members of OPEC decided to increase production in an effort to capture their share of market, have brought down the prices of a barrel of crude to less than US $11 and have made any rational analysis very complex. This has made even the proponents of the alternative energy sources pause and think. The US has, as usual, oscillated from panic to complacency. The Libyan crisis, however, has brought the dangers of complacency into sharp focus. The first commercial coal gasification plant, constructed with a capital investment of over US $2 billion, was abandoned by the owners and is being operated by the US Department of Energy temporarily. In their effort to find a private owner, the US Department of Energy has set the date of auction of this prestigious plant for May 28, 1986. And if an appropriate bid is not forthcoming, the plant faces a very uncertain future. Coal, considered by the World Coal Study (WOCOL) at MIT in 1980, to be a bridge to a global energy future, seems to have lost its luster due to the oil glut which we all know is temporary. This was evident when the bill to grant the Right of Eminent Domain for transportation of coal was defeated. This conference was organized to bring together experts in different areas from various countries to discuss the state of the art and the rate of progress in different alternative energy forms. The recent accident at the Chernobyl nuclear power plant in USSR has brought home the need of diversification of the alternative energy sources.

18385 (DOE/EIA—M025) The National Coal Model Versions 6 and 7: Software manual. (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). Jan 1988. 221p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88005467/JAW.

The National Coal Model-Versions 6 and 7, referred to as NCM6/7, are similar in concept, purpose and general capability to prior versions, in particular NCM5. NCM6 and NCM7 differ only in the handling of coal-fired utility plants. This Software Manual stands between the Model Description and Formulation document and the Users Manual and the three are addressed to different audiences. The Model Description and Formulation document is addressed primarily to analysts although it contains important background and reference material for the other two manuals. The Users Manual is mainly an operational manual, both for data maintenance and run submission. These two important but disparate aspects of model documentation have sometimes been mixed with software considerations, resulting in confusion to the user. This document is concerned almost exclusively with software. A model of the nature of the NCM inevitably takes its existence in the form of computer programs, files and procedures of considerable complexity. Although, generally speaking, this subject does not attract as wide an audience as either the analytical description or the operational details, it is extremely important that it be explained clearly and neither be confused by nor itself confuse other subjects.

18386 (NP—8751803) EDP-supported planning system for the optimisation of long-term production planning in coal mines. Vol. 2. Annex to main report. Kraushaar, D.; Meyer-Funke, A.G. (Ruhrkohle A.G., Essen (Germany, F.R.); Bergbau-Forschung G.m.b.H. Forschungsinstitut des Steinkohlenbergbauvereins, Essen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jul 1987. 584p. (In German). NTIS (US Sales Only), PC A25. Order Number DE88751803/JAW.

Assistance of the production planning by the mines of hard-coal mining company (RAG) for several decades. The planning system comprises methods of evaluating the coal reserves contained in unworked seams, winning areas and primary development requirements, investments and mining damages, of establishing and harmonizing production planning and of representing mine plans. To accomplish the required forecasts, evaluated data from operational data files are made available to the planning engineer.

2950 Hydrogen And Synthetic Fuels

REFER ALSO TO CITATION(S) 18384

18387 (DOE/OR/21400—H6) National Methanol Fuel Market Development. (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). Jan 1988. Contract AC05-84OR21400. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88005865/JAW.

This report examines the logistics of distributing fuel methanol in sufficient quantities to displace one million barrels per day of US gasoline use. It focuses on the likely nature of the fuel methanol distribution system, the areas of the US where methanol would be most competitive, and the capital costs associated with distribution equipment investments for methanol use. 6 figs., 11 tabs.

2960 Electric Power

REFER ALSO TO CITATION(S) 17702, 18370, 18382, 18384, 18402, 18419

18388 (CONF-870564—6) Using the minority energy assessment model to analyze electricity demand by black and nonblack households within a linear expenditure system framework. Poyer, D.A. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003121/JAW.

From Socioeconomic energy research and analysis conference; Washington, DC, USA (21 May 1987).

This paper presents an analysis of electricity demand by black and nonblack households over the period covered by the five residential energy consumption surveys issued by the Energy Information Administration (EIA) of the US Department of Energy (DOE). The analysis is based on research being conducted at Argonne National Laboratory under the auspices of the Research Program within the Office of Minority Economic Impact (MI) of the US Department of Energy (DOE). A primary objective of our research was the development of an analytical tool to assess the economic impact of energy policy on American minorities. The outcome of that process has lead to the developmemt of the Minority Energy Assessment Model (MEAM). The analytical backbone of MEAM is the energy demand equation which relates the quantity of energy demanded to prices, income, and other energy related demographic and household characteristics. It provides information that is essential for assessing the effects of policy on energy demand, energy expenditures, and economic well-being. We of course begin with the assumption that consumers are rational and have a well behaved demand function which is relatively stable over time. 12 refs., 4 tabs.

18389 (CONF-880212—1) Integrated resource planning at Puget Power: Process and results. Hirst, E.; Knutsen, C. (Oak Ridge National Lab., TN (USA); Puget Sound Power and Light Co., Bellevue, WA (USA)). 1988. Contract AC05-84OR21400. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003798/JAW.

From 15. annual energy technology conference and exposition; Washington, DC, USA (17 Feb 1988).

Puget Power responded to changes and challenges by establishing a Demand and Resource Evaluation program (DARE) in early 1986. DARE's objectives are enhancement of the internal planning process and development of a long-term plan. The overall goals of the plan and process were to keep energy-service costs low, improve customer service, increase flexibility for Puget Power and the Washington Utilities and Transportation Commission (WUTC), and reduce controversies over future resource acquisitions. This paper discusses the planning process and initial plan. Section 2 traces DARE's activities from inception through completion of the plan in November 1987. Sections 3 and 4 discuss future load growth and resource options. Section 5 summarizes results obtained with DARE's analysis and Section 6 interprets these results. 7 refs., 6 figs., 2 tabs.

18390 **(DOE/EIA—0226(87/09)) Electric power monthly, September 1987.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). Sep 1987. 45p. NTIS, PC A03/MF A01 - GPO; 1; GPO Dep. Order Number DE88005472/JAW.

This report focuses on the electric utility industry in the United States. The data in this report are presented for a wide audience including Congress, Federal and State agencies, the electric utility industry, and the general public. The Energy Information Administration (EIA) collected the information in this report to fulfill its data collection and dissemination responsibilities as specified in the Federal Energy Administration Act of 1974. 1 fig., 27 tabs.

18391 **(EPRI-EM—5579) A compendium of utility-sponsored energy efficiency rebate programs: Final report.** Berman, E.; Cooper, M.; Geller, H. (Consumer Energy Council of America Research Foundation, Washington, DC; American Council for an Energy-Efficient Economy, Washington, DC). Dec 1987. 276p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920103/JAW.

Rebate programs are becoming increasingly popular among utilities across the country as a method to persuade customers to purchase more energy efficient appliances, space conditioning systems, lighting products and motors. While there is substantial experience with and interest in utility rebate programs, utilities and other organizations lack comprehensive information on other utility-sponsored energy efficient rebate programs. The authors developed this Compendium to fill that gap. This Compendium contains information on 59 energy efficiency rebate programs, based upon a survey of 157 utilities. The information on each rebate program has been cross-tabulated and analyzed to identify such variables as program characteristics, products included, efficiency levels, rebate amounts, funding levels, energy and peak power savings, and the cost of peak demand reduction. Summary conclusions about these variables are also presented. 16 refs., 25 tabs.

18392 **(FRNC-R—162) Power utilities and energy conservation: the American example.** La Moriniere, O. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). 1985. 17p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752152/JAW.

In this paper, the various engagements of the electricity producers in the USA towards a more efficient utilization of energy are examined. It appears that the opposition between the producers and the "conservation" diminishes and that, on the contrary, the producers are spending up to 2.5 pc of their turnover in energy conservation research and development programs. These trends are justified by the lowering of the consumption due to energy prices and by the transfer of investments to the most profitable sectors. Application to the French case is discussed.

18393 **(NERC—8900302) 1987 electricity supply and demand for 1987-1996: Annual data summary.** (North American Electric Reliability Council, Princeton, NJ (USA)). Nov 1987. 163p. N. Amer. Elec. Reliab. Council, Research Pk, Terhune Rd., Princeton, NJ 08540. Order Number TI88900302/JAW.

The North Americal Electric Reliability Council (NERC) annually collects and publishes ten-year projections of electricity supply and demand of the nine Regional Reliability Councils. This Electricity Supply and Demand report provides this data for the 1987-1996 period. Data on peak demand, net energy for load, capacity resources, capacity margins, and planned additions and retirements of generating units have been extracted from reports submitted to the US Department of Energy by each Regional Reliability Council. Data on generating capacity, electrical energy production, fossil fuel requirements, planned conversions of units from oil to coal, and existing and planned additions of transmission lines were reported directly to NERC. Areas served by the nine Regional Reliability Councils are shown on the inside front cover of this report. The regional and subregional abbreviations used thoughtout this report are defined on the inside back cover. This report also includes forecast bandwidths around the most probable peak demand and annual net energy for load projections for NERC-US and NERC-CANADA. The projections for the United States and Canada are sums of the projections provided by the Regional Reliability Councils. The forecast bandwidths are intended to provide a better understanding of NERCs aggregated projections and to illustrate the uncertainty inherent in the forecasting process. Future uncertainties, many beyond individual electric utility control, could change the underlying asumptions of these projections, the projections themselves, and the trends indicated. 45 tabs.

18394 **(NP—8751953) Swiss electricity statistics 1986.** (Bundesamt fuer Energiewirtschaft, Bern (Switzerland)). 1987. 46p. (In German and French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751953/JAW.

With many figures and diagrams, the statistics describes the energy balance of Switzerland, the generation and consumption of electric power, load and supply curves, imports and exports of energy, the projected extension of production system until 1992, and the financial balance.

18395 **(ORNL/CON—247) Developing an integrated planning process: An electric utility case study.** Hirst, E.; Knutsen, C. (Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005833/JAW.

In early 1986, Puget Power established a Demand and Resource Evaluation (DARE) program, intended to improve the internal planning process and prepare a long-term integrated resource plan for the Company. This report describes DARE activities during its initial cycle, from establishment in February 1986 through submission of the first plan to the Washington Utilities and Transportation Commission in November 1987. Three specific examples of typical planning situations (problems and their resolution) are presented. The examples deal with the decision to adopt an integrated planning model as a supplement to the in-house corporate models, the amount of time required to carefully conduct computer analysis, and the need to recognize that marginal cost-of-service analysis is not just a requirement imposed by the Commission but a valuable tool to understand the costs of serving individual end uses. 13 refs., 3 figs., 3 tabs.

18396 **(ORNL/CON—249) Regulatory responsibility for utility integrated resource planning.** Hirst, E. (Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005835/JAW.

Integrated resource planning is a very important issue for electric utilities and their state regulatory commissions. Although much has been written about the obligations of the utilities, very little has been published concerning the roles and responsibilities of the state public utility commissions (PUCs). This report is based on the assumption that integrated resource planning can yield substantial benefits to utilities, their customers, and to commissions. However, these benefits will not be fully realized unless commisssions further develop their roles in improving the planning process and consequent plans. This report serves as an extended outline of issues that merit further consideration among commissions, the utilities they regulate, and other interested parties. 47 refs., 3 figs., 4 tabs.

18397 (ORNL/CON—251) Marginal-cost-of-service analysis: A powerful marketing tool for electric utilities. Hirst, E. (Oak Ridge National Lab., TN (USA)). Feb 1988. Contract AC05-84OR21400. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006052/JAW.

The profitability (difference between marginal revenues and marginal costs) of providing service to different market segments is a critical issue for electric utilities. Marginal cost-of-service analysis is a valuable and straightforward way to examine profitability. Such marginal-cost estimates, coupled with information on customer preferences and electricity-use patterns, can be used to design demand-side programs that improve customer service and lower electricity prices. This report presents results from a marginal-cost study for a hypothetical utility in the Pacific Northwest. The results from this study can be used to assess different types of customer programs aimed at improving energy efficiency, retaining market shares, or increasing sales. The specific examples concern space conditioning an office building, retention of existing residential water-heating loads (which would otherwise be lost through conversion to natural gas), promotion of high-efficiency electric space-heating in new single-family homes, and promotion of area lighting for large commercial buildings. Each example yields different insights about costs and revenues; their changes over time; and their sensitivities to load shapes, rate structures, and assumed lifetimes.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 17702, 17704, 17705, 17706, 17707, 18377, 18378, 18379, 18393, 18423, 18470

18398 (APA—8900271) Alaska electric power statistics, 1960-1986: Twelfth edition. (Alaska Power Authority, Anchorage (USA)). Nov 1987. 87p. Alaska Power Authority, 420 L St., Suite 100, Anchorage, AK 99501. Order Number TI88900271/JAW.

This publication includes data on electric utility systems, national defense installations and industrial facilities which supply power for their own use. Tables and graphs provide different viewpoints on energy use. Most data is presented by regional area of the state. Installed generation capacity, fuel use, and net generation data form a major part of this report. The report also includes information on transmission line systems in Alaska. The Market Data section presents information on utility sales, revenues, and customers. This year's report has a new section titled Utility Work in Progress. This section provides brief descriptions of utility projects undergoing feasibility analysis, design or construction. In response to our reader survey on last year's report, a reference section has also been added. The table following this letter presents a five-year summary of installed capacity and net generation for the utility, industry, and military sectors of the state's electric power producers. The table includes information on fuel resources, types of generation equipment, and percentages of growth between years. 15 refs.

18399 (CONF-870564—8) Residential energy consumption and expenditure patterns of black and nonblack households in the United States. Vyas, A.D.; Poyer, D.A. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003124/JAW.

From Socioeconomic energy research and analysis conference; Washington, DC, USA (21 May 1987).

Residential energy consumption and expenditures by black and nonblack households are presented by Census region and for the nation based on the Energy Information Administration's 1982-83 Residential Energy Consumption Survey (RECS). Black households were found to have significantly lower levels of electricity consumption at both the national and regional level. Natural gas is the dominant space heating fuel used by black households. Natural gas consumption was typically higher for black households. However, when considering natural gas consumption conditional on natural gas space heating no significant differences were found. 10 refs., 1 fig., 8 tabs.

18400 (NP—8770078) Simulation of the cumulated energy consumption of industrial products. Hartmann, D.R. (Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Elektrotechnik). 23 Jul 1986. 150p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88770078/JAW.

Considering the current state of methods, process chain analysis can be applied to simply structured process chains only if no unreasonable effort is to be involved. The aim of the continuation work was therefore to develop a method meeting the requirement of calculating cumulated energy consumption on the basis of a coherent mathematical description of relationships - while making use of the available basic definitions. Only algebraic linking of the relevant factors of energy economy in the form of production functions renders possible the use of up-to-date solution procedures reverting to matrix and graph theory. The solution presented, which consists in the computer-aided simulation of energetic process chains, demands the setting up of a data bank on a problem-orientation basis. That data bank comprises both specific energy-consumption values for parts of production and process technique as well as the cumulated energy consumption of a multitude of basic materials, semi-finished products, component parts, and products. Energy consumption for that purpose is differentiated according to electricity, fuel, and non-energetic consumption, from which the aggregate quantities end-use energy consumption and primary energy consumption can then be calculated as well.

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 17902, 18092, 18129, 18384, 19113, 20358

18401 (FRNC-R—170) Energy conservation in the oversea territories. (Agence Francaise pour la Maitrise de l'Energie, 75 - Paris). Jun 1985. 84p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752149/JAW.

The various actions of the AFME (French Agency for Energy Conservation) in the french overseas territories (Reunion, Martinique, Guadeloupe, Guyana, New Caledonia, Polynesy, etc...) are reviewed; for each zone, the different projects and realizations are described and analysed (investment, planning and costs) since 1981. The main actions are concerned with domestic water solar heating, photovoltaic electricity, mini-hydraulics, energy conservation in the residential, industrial, transportation sectors, and bioclimatic households.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

18402 Magnetohydrodynamic space power: An assessment of its potential in the strategic defense initiative. Staats, G.E. (Dept. of Energy, Pittsburgh, PA). pp 12 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The Strategic Defense Initiative Organization (SDIO) is pursuing a magnetohydrodynamic (MHD) assessment program that is being administered by the Department of Energy's Pittsburgh Energy Technology Center (PETC). Presently, MHD power conversion is considered to be a prime candidate for ground-based SDI operations, and a likely candidate for space-based applications. The objective of the research program now underway is to determine the feasibility of employing MHW (100's-1000's of MWs), MHD power systems for space-based burst power (100's-1000's of sec.) applications. This presentation includes a synopsis of the historical development of rocket-driven, open-cycle MHD power conversion in the US, from the late 1950's to the present time. A summary of some related developments in the USSR is provided as well as an overview of the requirements to be met and the obstacles that must

be surmounted if MHD power sources are to qualify as reliable, MMW space-based power sources.

18403 **A single-cylinder valveless heat engine.** Chen, N.C.J.; West, C.D. (Oak Ridge National Lab., Oak Ridge, TN). pp 1386-1389 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—). Contract AC05-84OR21400.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879070.

A single-cylinder, single-piston heat engine with no valves is described. Because heat is supplied from an external source, a wide variety of heat sources or fuels could be used. The ideal performance of the thermodynamic cycle is calculated. A reasonable power output and indicated efficiency appear to be attainable from a machine of practicable size, operating under very modest temperature and pressure conditions.

18404 **(DOE/ET/15601—24) Diagnostic development and support of MHD test facilities: Technical progress report for the period January, February, March 1986.** Shepard, W.S.; Cook, R.L. (Mississippi State Univ., Mississippi State (USA). MHD Energy Center). Apr 1986. Contract AC02-80ET15601. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003381/JAW.

Mississippi State University is developing diagnostic instruments for MHD power data acquisition and for support of MHD component development test facilities. Microprocessor-controlled optical instruments, initially developed for HRSR support, are being refined, and new systems to measure temperatures and gas-seed-slag stream characteristics are being developed. To further data acquisition and analysis capabilities, the diagnostic systems are being interfaced with MHD Energy Center computers. Additionally, technical support of the diagnostic needs of the national MHD research effort is being provided. 9 figs., 4 tabs.

3004 Thermionic Converters

18405 **(AD-A—186295/2/XAB) Close-spaced high-temperature Knudsen flow. Technical report (Final), 1 February 1983-15 May 1986.** McVey, J.B. (Rasor Associates, Inc., Sunnyvale, CA (USA)). 15 Jul 1986. 38p. (NSR—224). NTIS, PC A03/MF A01.

This work studied discharge processes in Knudsen-mode (collisionless), thermionic energy converters. Mechanisms for reducing the effects of electron space charge in such devices are essential for thermionic converters to produce useful current and power densities. The mechanisms studied are: reduction of space charge through a very close interelectrode gap (less than 10 microns); transport and retention of positive cesium ions generated by surface ionization; transport of positive cesium ions generated in an arc external to the electrodes; and the mechanism for enhanced current output due to a structured emitter in a mixed barium-cesium vapor. The experimental work used SAVTEC (Self-Adjusting, Versatile Thermionic Energy Converter) diode structures which were tested in a chamber containing 0.1 - 1.0 torr of cesium vapor. Comparison of measured volt-ampere curves with theory gave excellent agreement and indicated an interelectrode gap of 6.5 microns at an emitter temperature of 1250 K. A theoretical model of the collisionless thermionic diode was developed which included surface ionization, auxiliary ions from an external source, and trapping of charged particles in potential wells due to infrequent collisions. Studies showed that trapping of positive ions leads to a large, beneficial increase in current density. Using a diffusion analysis to couple this model to models of collision-dominated discharges gave predictions of the performance of SAVTEC devices in the presence of an auxiliary discharge, and led to design criteria for electrode size in order for auxiliary ionization to be effective.

3005 Fuel Cells

REFER ALSO TO CITATION(S) 18125, 18126, 18127, 18155, 18344, 18345, 18531

18406 **(DOE/METC—87/0257) Fuel cells: Technology status report.** (USDOE Morgantown Energy Technology Center, WV). 1986. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE87006525/JAW.

This report documents the status of the US Department of Energy's Fuel Cells Program as of the end of FY 86. The report consists of (1) an overview of the Fuel Cells Program including a brief discussion of how fuel cells work; (2) a synopsis of the Phosphoric Acid Fuel Cell (PAFC), Molten Carbonate Fuel Cell (MCFC), and Solid Oxide Fuel Cell (SOFC) Programs and their 1986 projects; (3) a discussion of the Fuel Cells Advanced Research and Technology Development (AR & TD) Program and projects; and (4) a summary of the Fuel Cells Systems and Applications Program. In 1986, stack development continued as the major thrust of the PAFC program. A 5-kW generator was fabricated and tested in the SOFC area. MCFC's successfully completed 5000 hours of submodule testing and plans were finalized for an 8-ft^2 full-area short stack cell. A common direction of fuel cell development has been to combine individual cells into groups called "stacks" or "modules" in order to increase power output. AR & TD provided information on reaction mechanisms and materials for MCFC's, SOFC's, and PAFC's. Systems Analysis and Applications development provided engineering and economic guidelines for MCFC's, SOFC's, and PAFC's to be used in a variety of utility and industrial settings. 23 refs., 22 figs., 4 tabs.

18407 (NP—8770039, pp 345-360) **Research and development of phosphoric acid fuel cell generation system.** Hijikata, Akemi. (Mitsubishi Electric Corp., Tokyo, Japan). 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

3 firms including Mitsubishi Electric Corp. have been entrusted by NEDO with joint research and development of a low-temperature low-pressure type of fuel cell generating system for distributed installation. In the first year of 1981, the 3 firms shared research in element techniques (on cell, lamination, and fuel-reforming device respectively). In the second year, the research and development were promoted based on the result of the first year, and the fundamental techniques were verified. In the third year 1983, element technique was enhanced toward improvement of characteristics, prolonged life, and enhanced reliability, and basic design was performed for a 1000 kW class generating plant. Then in the fifth year 1985, based on such a design, adjustment design of the plant, detailed design, production and factory test of the devices, transport, installation, wiring, piping and unit adjustment have been completed. (13 figs, 3 tabs)

18408 (NP—8770039, pp 361-381) **Research and development of moltem carbonate fuel cell generation system.** Hagimoto, Kazuo. (Toshiba Corp., Tokyo, Japan). 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

The research and development of this subject system were transferred from the Agency of Industrial Science and Technology to NEDO in 1984, and are scheduled to be continued till fiscal 1986. By the development of element technology of the fuel cell body, it is intended to produce and operate a layer-built cell of 10 kW class for the purpose of establishing the fundamentals to produce a real-sized fuel cell. In this instance, the development has been carried out on the basis of paste-type electrolyte, in the following procedure. Namely, research on methods of material selection, formation and production of parts for repeated use such as electrolyte and electrode, making of prototype single cell using the electrolyte layer and electrode prepared for a trial, examination of mass production of the cell components, study on improvement of parts and composition by single cell test, concrete studies in lamina-

tion techniques, production and test of 10 kW class cell, and so forth. (15 figs, 4 tabs, 5 photos)

18409 (NP—8770045, pp 359-380) **Research and development of phosphric acid fuel cell power generation system.** Sinobe, Kenji. (Fuji Electric Co. Ltd., Kawasaki, Japan). 20 Sep 1985. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

In Proceedings of parallel sessions for the 5th NEDO general assembly.

The research and development of a power generation system using the phosphoric acid type fuel cell was ordered by NEDO as a joint contract to three companies, Fuji Denki K.K., Fuji Denki General Research Institute K.K. and Mitsubishi Denki K.K., and subsequent to the research and development of the element technologies, a detailed design was carried out for the construction of the 1 MW plant as an objective. On the R and D of the element technologies, the cell technology, the overlaying technology and the fuel reforming equipment were selected, and the search for the cause of deterioration of cell properties, the evaluation on the cell composition and the electrode, the test production of the cell with electrode base plates and the evaluation of the base plate and the study on dynamic characteristics of the reforming unit under a variable load were carried out. Further, on the trial construction of the 1 MW class power plant and operation research, the basic plant specifications and plant components were first determined being followed by the detailed design on the power plant including the process flow, control system and etc. (17 figs)

18410 (NP—8770045, pp 381-398) **Research and development of molten carbonate fuel cell power generation system. Matrix type electrolyte method.** Kuno, Katsukuni. (Hitachi Ltd., Tokyo, Japan). 20 Sep 1985. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

In Proceedings of parallel sessions for the 5th NEDO general assembly.

This research was performed as one of the studies funded by NEDO. And the study is intended to develop a fuel cell of the high temperature type to be operated under the temperature around 650°C using an electrolyte of the alkaline metallic carbonate such as lithium carbonate, potassium carbonate and etc. and the main merit of the power generation system based on the fuel cell is the point that the high cell efficiency and the high power generation efficiency are obtainable. And the working principle is based on a reaction to produce water by the combination of hydrogen and oxygen whereas the system is different from other fuel cell systems in principle at the point where there is an indispensable need to supply carbon dioxide for the cathode. In this study, the development on the cell element technology and the overlaying technology was performed. As a result, it was found that on the electrode, a high performance is obtainable by a process to add either a second metal or a metallic oxide to a sintered nickel oxide. Further, on the overlaying technology, at the current density of 250 mA/cm^2, a maximum power density of 0.13 W/cm^2 was obtained. (24 figs)

18411 (NP—8770046, pp 917-926) **Research and development of phosphoric acid fuel cells. Dispersed generation system (low temperature and low pressure type).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

The target is to make a detailed design and partial production of a 1,000 KW class power plant. Based on the detailed design made in 1984, work done in 1985 was design adjustment, equipment manufacture, and installation at the plant site. Based on the engineering schedule made considering the work-sharing, site conditions, and license applications, detailed procedures were examined and the design adjustment was completed as scheduled. Production of the fuel cell body was completed and the installment of the reformer, control system, and BOP (Balance Of Plant) was completed. A part of the work was postponed to 1986 because of the delay of start of the installation work. (7 figs, 1 tab)

18412 (NP—8770046, pp 927-935) **Research and development of phosphoric acid fuel cells. Power generation system for replacing thermal power plant.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99/MF A01. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

The target of is to make a design and partial manufacturing of a 1,000 KW class power generation plant. Installation of the equipment started from September 1985, and the total schdule was prepared for the start up of the sub-system adjustment from January 1986. A schedule was made considering the carry-in timing of the equipment, air sealing and pressure testing. Present status is that the installation is completed and adjustment of the subsystems is being proceeded. An integral part of the fuel cell is completed although not yet installed. Production and installment of the reformer, control system, and BOP (Balance Of Plant) equipments were completed. (5 figures; 1 table)

18413 (NP—8770046, pp 937-946) **Research and development on molten carbonate fuel cell power generation system. Operation of test plant (Matrix type electrolyte process).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

Development of such elemental technology as selection of materials, molding method, and lamination was carried out, and a 10 KW class cell was tried to develop. (1) Trial making and performance evaluation of a single cell. Long-term stability of matrix materials was checked as a study on the selection of the electrolyte plate materials aiming at establishing the method of production. A compact single cell was trially made and its performance was tested aiming for the improvement of the cell performance. (2) Development of the cell lamination technology. Investigation was made concerning the structure of a separator with high gas dispersion, and a mechanism of gas supply and exhaust for enabling a uniform flow in the laminated cell.

18414 (NP—8770046, pp 947-955) **Research and development on molten carbonate fuel cell power generation system. Operation of test plant (paste type electrolyte process).** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

The aim of this study is to establish the basis for the development of a large laminated cell for the future practical use through the development of such essential technologies as for selecting, molding and manufacturing, as well as laminating the material which composes a molten carbonate fuel cell and also through the development of a 10KW test cell. The following works were made in 1985 along the above lines: (1) Experimental manufacture of a single cell and its performance evaluation — As a step of the research on the electrolyte composition, a continuous manufacturing method of fine-powdered LiA_2O_3 was developed and conditions were sought for composing paste electrolyte layers which enable easy assembly of large laminated cells. Furthermore a study and evaluation were made about the cell's thermostability resulting from improved stability of reinforced material(ZrO_2) for electrolyte layers. 50cm square electrolyte layers were experimentally manufactured. (2) Development of lamination technology — A model laminated cell was manufactured and its cooling method was studied. A 3KW-class laminated cell was made experimentally using 20 of th above 50cm square electrolyte layers and through its electricity tests, problematical points were detected. (3) Basic design of a 10KW laminated cell — The basic design of a 10KW laminated cell was prepared. Its manufacturing and testing will be made in two years. (1 tab, 5 figs)

18415 **Monolithic fuel cells.** Fee, D.C.; Billone, M.C.; Busch, D.E.; Dees, D.W.; Dusek, J.; Easler, T.E.; Ellingson, W.A.; Flandermeyer, B.K.; Fousek, F.J.; Heiberger, J.J. (Argonne National Lab., Argonne, IL 60439). pp 803-807 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—). Contract W-31-109-ENG-38.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879202.

A new fuel cell design, called the "monolithic fuel cell," is being developed at Argonne National Laboratory. The monolithic design employs the same thin ceramic components used in other oxide fuel cells in a strong, lightweight honeycomb structure of small cells, and thus can achieve very high power per unit mass or volume. The light weight and low volume, as well as the efficiency and reliability of electrical systems, are advantageous in space systems. Considerable progress has been made in developing monolithic fuel cells. Small arrays (stacks) of monolithic fuel cells having prototypical dimensions have been fabricated and operated.

18416 (DOE/METC—87/6079-Vol.1, pp 204-209) **Effects of halides on the performance of coal gas-fueled molten carbonate fuel cells.** Kunz, H.R.; Magee, T.P. (International Fuel Cells, South Windsor, CT). Aug 1987. NTIS, PC A16/MF A01. Order Number DE87006495/JAW. (CONF-870659—Vol.1). Contract AC21-86MC23136.

From 7. annual gasification systems conference; Morgantown, WV, USA (16 Jun 1987).

The objectives of this contract are to develop a model and determine the probable limits of halides in fuel and oxidant streams to achieve a desired coal-gas-fueled molten carbonate fuel cell life between 25,000 and 40,000 hours. The information will be useful in the development of the coal gasifier/molten carbonate fuel cell power plant since it will define the gas cleanup and cell tolerance requirements that enable the mating of the coal gasifier with the fuel cell. The program consists of several tasks. First, a literature survey and thermodynamic analyses were performed to determine the anticipated effects of halides. These results were used to formulate a test plan. The tests consist of laboratory out-of-cell measurement of the performance of anodes and cathodes with halides present in the electrolyte and corrosion measurements on materials of construction. In-cell tests will be performed and all the data modeled to enable the prediction of the effects of halides on cell performance. Results to date are discussed.

18417 **Solubility of NiO in molten carbonates.** Shores, D.A. (Minnesota Corrosion Research Center, Univ. of Minnesota, Minneapolis, MN 55455). pp 1023-1027 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—).

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879142.

The NiO cathodes in molten carbonate fuel cells slowly degrade owing to a dissolution - precipitation mechanism. To understand this problem to the extent that it can be modeled in a reasonably quantitative fashion requires knowledge of NiO dissolution reactions, knowledge of the solubility under appropriate conditions and knowledge of transport mechanisms. This paper reports on some experimental measurements of the solubility of NiO in several molten carbonate solutions. The interpretation of the solubility data in terms of simple dissolution reactions was unsatisfactory. It is suggested that dissolution reactions involving the formation of stable complex Ni ions could account for the solubility data, but we have no independent confirmation of the existence of such ions.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 18380

18418 **(CONF-8507167—1) Jamaica Integrated National Energy Planning Model.** Macal, C.M. (Argonne National Lab., IL (USA)). [1987]. Contract W-31109-ENG-38. 2p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002923/JAW.

From Energy symposium; Kingston, Jamaica (15 Jul 1985).

The Jamaica Integrated National Energy Planning (JINEP) Model was developed by Argonne National Laboratory under contract to the Jamaica Ministry of Mining, Energy, and Tourism. JINEP is a comprehensive model of the energy-producing sector and the major energy consuming sectors of Jamaica. The JINEP Model is an application of a modelling system, the Integrated Demand and Energy Supply (IDES) Model, that was previously developed at Argonne for the purpose of analyzing energy systems of developing countries. IDES is based on several years of experience in analyzing energy planning issues characteristic of developing countries.

18419 **(DOE/CE/76248—T1) Technical and analytical support for the DOE's Office of Conservation and Renewable Energy: Final report.** (Electrotek Concepts, Inc., Knoxville, TN (USA)). Nov 1987. Contract AC01-84CE76248. 362p. NTIS, PC A16/MF A01; 1; GPO Dep. Order Number DE88005356/JAW.

This report summarizes all task order work conducted under this contract. Each task and result are described. The object of interest in this contract is electric power system research. (JDH)

18420 **(ORNL/M—407) Technical assistance supplement for 1987 SECP/EES/ICP Program managers conference.** White, D.L.; Freeman, L.M.; Zwack, W.A.; Mihlmester, P.E.; Brown, M.A. (Tennessee Univ., Knoxville (USA); Applied Management Sciences, Inc., Oak Ridge, TN (USA); Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 35p. (CONF-8709205—Suppl.). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87014361/JAW.

From SECP/EES/ICP program managers conference; Vill. at Smuggler's Notch, VT, USA (15 Sep 1987).

This paper consists of a list of energy conservation programs in the United States. A brief description of the programs and their objectives is given. (JDH)

3201 Buildings

REFER ALSO TO CITATION(S) 18062, 18323, 18391, 19114, 19129, 19131, 19132, 19138, 19156, 19159, 19196, 19212, 19216, 19228, 19230, 19233, 19247, 19600, 19658, 20638, 20657, 20658

18421 **(EPRI-EM—5567) Residential, commercial, and agricultural technology alternatives for rural electric systems: Final report.** McFate, K.L.; Skelton, J. (National Food and Energy Council, Columbia, MO (USA); Battelle Columbus Div., OH (USA)). Jan 1988. 188p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920171/JAW.

This report contains information on demand-side management technology alternatives applicable to the residential, agriculture and commercial sectors. Descriptive information on operating characteristics, applicability, specifications, and consumer and utility benefits is provided in a standardized Technical Brief format for 78 technologies. Matrices are included to guide the reader in the intuitive application and use of the information contained in the Technical Briefs. This report is considered a companion to EPRI publication EM-4385 entitled, "Demand-Side Management for Rural Electric Systems."

18422 **(GB—113) Flow and heat transfer within mechanically-ventilated enclosures.** Hammond, G.P.; Alamdari, F.; Montazerin, N. (Cranfield Inst. of Tech., Bedford (UK). School of Mechanical Engineering). Oct 1986. 12p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751767/JAW.

It is now widely recognised that in order to develop realistic methods for the energy-conscious design of buildings, it is necessary to replace the traditional steady-state procedures by ones whch simulate the dynamic thermal response of the system. However, a weakness in all the modern approaches to building thermal modelling is that emphasis has been placed on simulating the transient performance of the building fabric, while the air flow and convective heat exchange in and around the structure are modelled using only rough approximations. In order to obtain improved convective heat transfer data for building thermal models, a hierarchy of interacting and interdependent calculation methods have been developed at Cranfield.

18423 (IDRC-TS—59e) Urban energy in Fiji: A survey of Suva's household, industrial, and commercial sectors. Siwatibau, S. (International Development Research Centre, Ottawa, Ontario (Canada)). 1987. 82p. International Development Ctr., P.O. Box 8500, Ottawa, Ontario, Canada K1G 3H9. Order Number TI88900252/JAW.

In many developing countries, such as Fiji, energy planning and energy policy formulation represent a relatively recent phenomenon. Such processes are needed, for example, to develop strategies for substituting imported oil with local energy sources. Before such a process can begin, however, the sources and uses of energy must be known. A survey was, therefore, undertaken of 1011 electrified households, 301 nonelectrified households, 76 industrial establishments, 77 commercial concerns, and 10 large office buildings to determine energy-use patterns in Suva, capital city of Fiji. Most households in Suva rely on kerosene for their cooking-fuel needs. As income declines, however, reliance on firewood increases. Gasoline for private cars accounts for 38% of total energy consumption by households in Suva. Suva's industrial sector uses 96% of its energy for production purposes, such as for steam and hot water. Most of this energy comes from coal (77%). Electricity is used in 15 of 17 end-use categories in Suva's commercial establishments. Air-conditioning (14%) represents the largest single end-use, particularly in large office buildings, followed by refrigeration (13%) and cooking (11%). Liquified petroleum gas (LPG), kerosene, and wood are also used for cooking by many establishments. 9 refs., 20 figs., 28 tabs.

18424 (LBL—23167) The San Francisco Public Housing Tenant Incentive Program: The response of elderly participants. Vine, E.; Barnes, B.K.; Mills, E.; Ritschard, R. (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88004900/JAW.

In 1985, the City of San Francisco initiated a tenant incentive demonstration project in public housing to stimulate energy conservation behavior among its tenants. The goals of the incentive demonstration project were to demonstrate energy savings and to measure the effectiveness of financial incentives in public housing. Two buildings for the elderly were selected to participate in the program (1880 Pine and 350 Ellis). Energy conservation workshops were held at both buildings; however, only the tenants at 1880 Pine received the incentives. We present the findings of a survey conducted among a sample of tenants at each of these buildings. 8 refs., 39 figs., 12 tabs.

18425 (PNL-SA—15329) Building energy conservation projects at Pacific Northwest Laboratory. Secrest, T.J. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 34p. (CONF-8711140—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005172/JAW.

From Housing for the 90's trade show and conference; Tacoma, WA, USA (2 Nov 1987).

This is a collection of project descriptions of building energy conservation research being conducted at Pacific Northwest Laboratory for the US Department of Energy, the Bonneville Power Administration, and other government and private clients.

18426 (SERI/SP—270-3200) Energy Conservation Technical Information Guide: Volume 1, Resource directory. (Solar Energy Research Inst., Golden, CO (USA)). Sep 1987. Contract AC02-83CH10093. 144p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE87012269/JAW.

This directory is one of a set of energy-conservation technical information guides (TIGs) designed to help you find information about conservation technologies. It is written for several audiences, including scientists and engineers, university researchers, manufacturers, and utility policy-makers and planners. The directory lists the primary research and other organizations involved with the federal conservation research program and similar efforts. Textual and computerized information sources are also provided. This technical information guide (TIG) is a multivolume overview of energy-conservation techniques and technologies in the buildings and utility sectors.

18427 (DOE/CE/64609—T1) Wisconsin preventive maintenance, repair, and operational services PROS [Preventive Maintenance, Repair and Operational Services] Pilot Program: Final report. (Wisconsin Dept. of Administration, Madison (USA). Div. of Energy and Intergovernmental Relations). [1987]. Contract FG01-86CE64609. 344p. NTIS, PC A15. Order Number DE88004706/JAW.

Since 1979, the Institutional Conservation Program's main emphasis has been on funding capital improvements to increase the energy efficiency of schools and hospitals. Improved building operation and maintenance techniques as a means to reduce energy consumption have been encouraged, but despite evidence showing greatly increased energy savings from such efforts, relatively little has been accomplished in this area. To meet this deficiency, the Wisconsin Preventive Maintenance, Repair and Operational Services (PROS) Pilot Program was designed to increase and maintain the energy efficiency of schools by emphasizing building operation and maintenance techniques within the context of an overall facility management program. The PROS final report provides complete documentation of the project's history, operations, methods, and results for those who might want to replicate the program. Drawing upon Wisconsin's experience, this report will also indicate areas in which the program might be improved.

18428 (PB—88-126826/XAB) Effect of HVAC (heating, ventilation, and air-conditioning) systems on energy management. Roos, R. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning). 1987. 108p. NTIS, PC E05/MF A01.

This study is concentrated on four states in the U.S. (Iowa, Michigan, Minnesota and Wisconsin) and Finland. The study consists of five main chapters. These are: factors effecting on the HVAC technical decisions; typical HVAC systems in the U.S.; flexibility, technical properties and energy efficiency of typical conventional HVAC systems in the U.S.; new VAC systems and equipment; and electricity consumption peak levelling. The most-important factors effecting the HVAC technical decisions are: climate, primary energy sources, construction industry, community structure, and various standards and codes.

18429 (RFP—4164) Use of annual profiles of hourly data for analyzing DOE-2 building simulation program results. Haberl, J.; MacDonald, M.; Eden, A. (Management Information Support, Denver, CO (USA); Oak Ridge National Lab., TN (USA); Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). Jun 1987. Contract AC04-76DP03533. 42p. (CONF-880128—4). NTIS, PC A03. Order Number DE88005338/JAW.

From ASHRAE winter meeting; Dallas, TX, USA (30 Jan 1988).

This paper presents an approach for improving potential building energy analyses using the DOE-2 computer program. The approach makes use of the ability to generate hour-by-hour data results from DOE-2 simulations, and uses a plotting package to generate 3-dimensional annual profiles of the hour-by-hour data for specific quantities of interest. The annual profiles of hourly data provide a graphical check of voluminous data in a condensed form allowing several different types of data to be plotted over a year. These profiles provide the user the opportunity to: check simulation results, check potential problems with simulations, provide graphs to customers who may want a simpler presentation, visualize interactions in simulations, and understand where weak areas may exist in simulations. Future analysis, using such profiles, may allow methods to be developed to check consistency between simulations, check for potential errors in modeling buildings, and better understand how simulations compared with data from real buildings. 14 refs., 24 figs.

18430 (BNL—52068-Vol.1) Proceedings of the 1987 international symposium on condensing heat exchangers. (Battelle Columbus Labs., OH (USA)). Apr 1987. Contract AC02-76CH00016. 238p. (GRI—87/00912-Vol.1; CONF-8704247—Vol.1). NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88004489/JAW.

From International symposium on condensing heat exchangers; Columbus, OH, USA (14 Apr 1987).

This volume presents papers from a recent conference discussing high-efficiency heating equipment for residential and commercial users. The emphasis was on equipment designed to operate with condensing heat exchangers. Specific topics include: (1) condensate characterization, (2) metallic and ceramic materials for heat exchangers, (3) design techniques and (4) field experience. The twenty-six papers are indexed separately. (JDH)

18431 **(BNL—52068-Vol.2) Proceedings of the 1987 international symposium on condensing heat exchangers.** (Brookhaven National Lab., Upton, NY (USA)). Apr 1987. Contract AC02-76CH00016. 224p. (GRI—87/0091.2; CONF-8704247—Vol.2). NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88005230/JAW.

From International symposium on condensing heat exchangers; Columbus, OH, USA (14 Apr 1987).

Technology for advanced, high-efficiency heating equipment was discussed. Twenty-six papers from nine countries were presented, covering various aspects of such equipment designed to operate with condensing heat exchangers - including furnaces, boilers, water heaters, and fuel-fired heat pumps. The emphasis was on residential and commercial equipment, and both gas- and oil-firing were considered. Specific topics included: (1) condensate characterization; (2) metallic materials for condensing heat exchangers - aluminum and stainless steel; (3) non-metallic materials for heat exchangers and vents - ceramics and polymers; (4) example condensing units and systems; (5) experience with oil-fired condensing units; (6) field experience; (7) design techniques and efficiency test procedures. Papers are indexed separately.

18432 **(BNL—52105) Thermal Distribution Program Plan: Part 1, Forced-air distribution systems in residential and small commercial buildings and Part 2, Hydronic and radiant heating and cooling systems.** (Brookhaven National Lab., Upton, NY (USA)). Sep 1986. Contract AC02-76CH00016. 92p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88006025/JAW.

This document is intended to serve as a basis for the US Department of Energy's (DOE's) multilayer plan for research on thermal distribution and utilization (TDU). In this document, the areas of research included under the heading of thermal distribution and utilization are defined, their benefits are shown, and a ten-year program of research is recommended. Part I of the Plan concentrates on forced-air thermal distribution systems in residences and small commercial buildings. Part II covers hydronic and radiant systems. TDU research refers to the study of the phenomena associated with the transport of heat and cooling effect from the central heating or cooling equipment via pipes or ductwork to the building spaces to be comfort conditioned. The intent of the research is to maximize the thermal performance of buildings, where thermal performance is defined as the ratio of person-hours of thermal comfort provided, divided by the energy required to provide that comfort. TDU research will improve thermal performance by reducing the thermal losses occurring in ductwork, and by prviding acceptable means of zoned heating and cooling of building spaces. 18 figs., 7 tabs.

18433 **(CONF-871204—5) A study of the viability of ice storage for the Nevada Test Site.** Davis, R.E. (Holmes and Narver, Inc., Mercury, NV (USA)). 1987. Contract AC08-86NV10471. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005517/JAW.

From 8. Miami international conference on alternative energy sources; Miami Beach, FL, USA (14 Dec 1987).

This paper will present the results of two studies conducted to assess the potential for reducing both energy and demand charges for comfort cooling for a southwest high desert environment. The initial study was devoted to the comparison of six different mechanical refrigerated cooling systems, one of which included the ice storage option, and was directed only to an understanding of peak demand charge avoidance. The follow-on study focused on the annual performance of the two most effective systems from the first analysis. While the ice storage option did offer a monetary savings over the full year, it was responsible for a larger annual energy consumption. 3 figs., 5 tabs.

18434 **(CONF-871204—6) Multiple-stage evaporative cooling for a high desert environment.** Davis, R.E. (Holmes and Narver, Inc., Mercury, NV (USA)). 1987. Contract AC08-86NV10471. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005518/JAW.

From 8. Miami international conference on alternative energy sources; Miami Beach, FL, USA (14 Dec 1987).

This paper will present the results of an analysis as to the utility of multiple-stage evaporative cooling as the potential replacement for mechanical refrigeration cooling. The high desert area of the southwest United States provides excellent summer weather conditions for the application of evaporative cooling technology for comfort conditioning. Unfortunately, the high relative humidity that results from traditional single-stage evaporative cooling equipment is not desirable for today's commercial office environments with their high reliance upon electronic devices. In the past few years, a renewed interest in multistage evaporative cooling has led to the marketing of equipment that can provide up to four stages of cooling effect and provide thermal comfort levels equal to those provided by mechanical refrigerated cooling systems. Evaporative cooling equipment requires less operating energy than like capacity mechanical systems, resulting in lower operating costs. This recently completed study evaluated the thermal and cost-effectiveness of two-, three-, and four-stage evaporative cooling systems for today's modern office environment. 12 figs., 4 tabs.

18435 **(CONF-880128—2) Laboratory testing of a heat pump system with water-to-water, counterflow heat exchangers using various compositions of an R13B1/R152a nonazeotropic refrigerant mixture.** Vineyard, E.A. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003550/JAW.

From ASHRAE winter meeting; Dallas, TX, USA (30 Jan 1988).

Testing was performed with a nonazeotropic refrigerant mixture of R13B1/R152a to determine its ability to achieve capacity, relative to R/22, at low ambient temperatures. The selection of such a mixture could improve the efficiency of a heat pump by decreasing the cycling losses, which account for approximately 7-12% of the annual energy use, along with decreasing the amount of resistance heat required at low ambient temperatures. Results for the mixture show a potential capacity modulation from 12431 Btu/hr (3643 W) at 17 F (-8.3 deg C) to 8550 Btu/hr (2506 W) at 47 F (8.3 deg C) in heating and from 7451 Btu/h (2184 W) at 82 F (27.8 deg C) to 9188 Btu/h (2693 W) at 95 F (35 deg C) in cooling. An analysis of the coefficients of performance for the mixture and its pure components is presented along with a comparison against results obtained with R/22. The comparison is based on maintaining equivalent inlet and exit water temperatures in the evaporator and condenser for both R/22 and the mixtures. 4 refs., 8 figs., 4 tabs.

18436 **(CONF-880128—5) Efficiency characteristics of speed modulated drives at predicted torque conditions for air-to-air heat pumps.** Rice, C.K. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005846/JAW.

From ASHRAE winter meeting; Dallas, TX, USA (30 Jan 1988).

Examples of system (motor + inverter drive) efficiencies of two types of adjustable speed control are compared for predicted compressor and indoor blower load profiles. The two classifications are inverter-driven induction motors (IDIMs) and permanent-magnet electronically commutated motors (PM-ECMs). Reference sine-wave-driven induction motor (SWDIM) efficiencies are also given. Available bench data on late 70's IDIM compressor drives are compared to recent data on IDIM and PM-ECM drives. The drive efficiencies are compared over common operating torque requirements for heating and cooling. A modulating heat pump model was used to develop predicted reciprocating compressor torque/drive-frequency mappings and the expected operating torque ranges. The variation in modulating compressor torque requirements is analyzed. Ways to adjust the torque relation for different compressor types and sizing strategies are also discussed. Modulating blower performance data on an early '80s generation modulat-

ing heat pump with an IDIM drive (and SWDIM reference drive) were obtained from Miller (1988) and compared to bench data on recent IDIM and PM-ECM drives under similar torque conditions. In both compressor and blower applications, the combined system efficiency of the PM-ECM drives is nearly equal to or higher than that of the reference SWDIM cases and significantly better than IDIMs available in the late '70s. When compared to more recent IDIMs, the PM-ECM efficiency advantage over IDIM compressors has been reduced 40 to 50% between half and nominal speed (3600 rpm) but still remains 14 to 9% higher, respectively. For blowers, the IDIM improvement has not been as great. PM-ECM-driven blowers appear competitive at present with IDIM blowers on combined efficiency, cost, and reliability. For the compressor PM-ECM drives, if progress continues, these drives will likely be a leading candidate for future modulating heat pumps. 24 refs., 13 figs., 5 tabs.

18437 **(DOE/SF/16528—T1) Parametric study and optimization of an open-cycle adiabatic solid desiccant cooling system.** Lavan, Z.; Worek, W.M. (Illinois Inst. of Tech., Chicago (USA); Chicago Univ., IL (USA)). 28 Jan 1988. Contract FG03-86SF16528. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005258/JAW.

The performance of an open-cycle adiabatic solid desiccant cooling system operating in the ventilation mode is modeled numerically. The effect of nondimensional dehumidifier channel length, desiccant mass fraction and desiccant isotherm shape are investigated. The results show the conditions where the system has optimum thermal coefficient of performance (COP). 13 refs., 10 figs., 1 tab.

18438 **(DOE/SF/16528—T2) Effect of heat and mass transfer properties on desiccant dehumidifier and cooling system performance.** Lavan, Z.; Worek, W.M. (Illinois Inst. of Tech., Chicago (USA)). 28 Jan 1988. Contract FG03-86SF16528. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005259/JAW.

A mathematical model describing the heat and mass transfer processes that occur during sorption of water vapor in a dehumidifier consisting of parallel channels lines on either side with desiccant felt is presented. The model includes both gas-side and solid-side resistances for thermal and mass transport. The moisture diffusion in the desiccant is expressed by considering both gas phase diffusion and surface diffusion. The heat and mass transfer in the desiccant matrix occurs simultaneously and is coupled by an equilibrium sorption relation which is applied locally within the desiccant. Solutions are obtained by using an explicit finite-difference scheme. The effect of heat and mass transfer Biot numbers and other parameters on the performance of the desiccant dehumidifier and the cooling system are theoretically investigated. 26 refs., 9 figs., 1 tab.

18439 **(EPRI-EM—5437) Water-loop heat pump systems: Assessment study: Final report.** Pietsch, J.A. (Pietsch (Joseph A.), Dallas, TX (USA)). Jan 1988. 198p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920170/JAW.

A state-of-the-art assessment of water-loop heat pump (WLHP) systems is presented. Nonresidential building space heating and cooling market trends and forecasts are reviewed as is the position of WLHP systems in the nonresidential market. The size and characteristics of the future nonresidential market are estimated, and the opportunities for growth of WLHP systems are quantified. First cost and operating cost comparisons of WLHP systems with other comfort conditioning systems are presented. Concepts for improved water loop system design and operation for reducing system energy costs are presented. These include extended loop temperature range, increased loop storage capability, and adjusted water flow rates. Research recommendations for enhancing heat pump and system performance are outlined. 38 figs., 48 tabs.

18440 **(FRNC-TH—3044) Study of chemical solid-gas heat pump used for low temperature thermal storage.** Bourdeau, M. (Ecole Centrale des Arts et Manufactures, 92 - Chatenay-Malabry (France)). Jun 1985. 105p. (In French). NTIS (US Sales Only), PC A06. Order Number DE88752150/JAW.

The objective of this study was to analyse the potential of the chemical heat pumps (with reversible reactions between solid and gaseous phases at low temperature) and their application to heat transportation, storage, and reutilization for space heating. Comparison is done between container type heat transport with chemical heat pump and other heat transport and storage system (sensible heat). The short and long term solar energy storages are also analysed in this context and the results of simulations are presented. A theoretical study of the coupled heat and mass transfers in the reaction media (assimilated to a porous layer) is used to optimize the dimensions and operation of the reactors.

18441 **(LBL—21476) Pupillary size differences under incandescent and high pressure sodium lamps.** Berman, S.M.; Jewett, D.L.; Bingham, L.R.; Nahass, R.M.; Perry, F.; Fein, G. (Lawrence Berkeley Lab., CA (USA); California Univ., San Francisco (USA)). Apr 1986. Contract AC03-76SF00098. 25p. (CONF-8608179—3). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004564/JAW.

From Annual Illuminating Engineering Society conference; Boston, MA, USA (16 Aug 1986).

Eight healthy young adult subjects produced significantly larger steady state pupil areas, as measured by infra-red pupillometry, when exposed to indirect lighting from high frequency high pressure sodium lamps compared to photopically matched levels of indirect incandescent lamps at three levels of luminance: 30, 60 and 90 candelas per meter squared (cd/m2). Three additional intensities were studied, which were not matched photopically between lamps. Analysis of all data showed that a scotopic spectral distribution accounted for pupil size better than either a photopic spectrum or an Alpern-Campbell pupillary response spectrum. Because pupil size can affect visual functioning, these results suggest that control of pupil size should be considered in lighting design and that the scotopic spectral output from lamps should be important in determining the effectiveness of a lighting environment. 14 refs., 15 figs., 3 tabs.

18442 **(LBL—21820) Overview of advances in light sources.** Hollister, D.D. (Lawrence Berkeley Lab., CA (USA)). Jun 1986. Contract AC03-76SF00098. 10p. (CONF-860880—58). NTIS, PC A02. Order Number DE88004567/JAW.

From 30. SPIE technical symposium on optics and optoelectronic engineering; San Diego, CA, USA (17 Aug 1986).

Current efforts at the Lawrence Berkeley Laboratory to improve the operational efficiency of fluorescent lamps are based upon novel techniques intended to reduce internal resonance radiative transport losses. Such losses have been associated with "entrapment" of resonance radiation in the optically thick positive column of the mercury vapor disharge. Two promising techniques for entrapment reduction are provided respectively to selective mercury isotope enrichment and by the broadening of the hyperfine structure (hfs) of the resonance line λ2537 via the Zeeman effect. These techniques have, thus far, led to fluorescent lamp uv production efficiency enhancements, respectively of about 6.8% and 7%. 19 refs., 9 figs., 2 tabs.

18443 **(LBL—22531) Fixture conditions affect lamp performance.** Siminovitch, M.J.; Rubinstein, F.M.; Verderber, R.R. (Lawrence Berkeley Lab., CA (USA)). Nov 1986. Contract AC03-76SF00098. 13p. (CONF-851071—7). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004565/JAW.

From IEEE-Industry Applications Society annual meeting; Toronto, Ontario, Canada (6 Oct 1985).

This article discusses the major parameters that affect fluorescent lamp performance under fixture conditions. These parameters include fixture type, and HVAC integration, which directly determine the minimum lamp wall temperature (MLWT), and therefore, the resulting light output of the lamp/ballast system. Experimental data is presented showing that the lumen output of the lamp/ballast system can vary by as much as 20% and that the system efficacy can vary by 10% depending upon the type of fixture and HVAC system employed. 4 refs., 5 figs., 1 tab.

18444 (LBL—23169) Measurement of optical efficiency of fluorescent luminaires. Verderber, R.R.; Morse, O.; Rubinstein, F.; Siminovitch, M. (Lawrence Berkeley Lab., CA (USA)). Jan 1987. Contract AC03-76SF00098. 17p. (CONF-8708204—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004569/JAW.

From Annual Illuminating Engineering Society conference; Scottsdale, AZ, USA (2 Aug 1987).

By controlling the lamp wall temperature of fluorescent lamps with a Peltier device, the optical efficiency of luminaires can be measured directly. Measurements of the fixture efficiency for a luminaire can vary by over 8% depending upon the lamp-ballast system used in the measurement. The authors suggest that optical efficiency may be an improved metric for evaluating fixture designs. 6 refs., 3 figs., 5 tabs.

18445 (ORNL/TM—9894) Impact of air-filter condition on HVAC [heating, ventilation, and air conditioning] equipment. Jung, L. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004775/JAW.

An analysis was performed of changes in energy consumption caused by dirty filters for heating, ventilation, and airconditioning systems during both heating and cooling cycles. Basic heat-transfer fundamentals and the vapor-compression refrigeration cycle for air conditioners were used. The energy cost savings between a dirty and a clean filter were small and were mainly offset by the filter cost. However, the consequences of deferring filter replacement could be very costly because of early equipment failures. 19 refs., 5 figs., 6 tabs.

18446 (ORNL/TM—10264/V2) Occupant evaluation of commercial office lighting: Volume 2, Preliminary data analysis. Marans, R.W.; Brown, M.A. (ed.). (Michigan Univ., Ann Arbor (USA)). Nov 1987. Contract AC05-84OR21400. 88p. NTIS, PC A05. Order Number DE88004767/JAW.

This report presents the preliminary results of a post-occupancy evaluation of office lighting environments. It explores the relationship between quantitative measures of lighting in occupied environments and qualitative measures related to occupant satisfaction. The report analyzes several types of data from more than 1000 occupied work stations: subjective data on attitudes and ratings of selected lighting and other characteristics, photometric and other direct environmental data, including illuminances, luminances, and contrast conditions, indirect environmental measures obtained from the architectural drawings and the work station photographs, and descriptive characteristics of the occupants. The work stations were sampled from thirteen office buildings located in various cities in the United States. Many tentative findings emerged from the analysis, including the following: (1) within the range of values examined here, there is a tendency for lighting satisfaction to decrease as lighting power density increases; (2) occupants who described their work station spaces as bright also tended to be satisfied with their work station lighting; (3) occupants who were most bothered by bright lights and glare were most likely to express dissatisfaction with the lighting at their work stations; (4) there is no relationship between work-related activities of employees and indicators of lighting quality. More research is needed before firm conclusions can be drawn and before guidance regarding lighting standards and other policy issues can be derived. 3 refs., 9 figs.

18447 (PB—88-129259/XAB) Higher-lift lower-cost absorption cycles. Phase 1, final report. Erickson, D.C.; Davidson, W.F. (Energy Concepts Co., Annapolis, MD (USA)). Jul 1985. 26p. NTIS, PC A03/MF A01.

The purpose of the research was to determine if modified NaOH solutions could be used in absorption heat pumps (AHP) to provide higher heat-pumping lifts from low ambient temperatures than are now possible. The research consisted of performing screening experiments on a great number of modified alkali hydroxide solutions, in order to characterize and bound the properties of boiling-point elevation, solubility limit, and corrosivity as a function of composition. Two preferred compositions were selected for more-detailed characterization: the binary NaOH-KOH and the ternary NaOH-KOH-CsOH. Lifts as high as from 0 to 90C were shown to be possible, which will extend AHP applicability into several important new applications.

18448 (PB—88-142138/XAB) Porous-glass materials as desiccants. Final report, March-September 1987. Mullins, M.E. (Research Triangle Inst., Research Triangle Park, NC (USA)). Nov 1987. 37p. NTIS, PC A03/MF A01.

It has been determined previously that the desiccant that would most enhance the performance of desiccant cooling systems is one with a well-defined Brunauer Type-I isotherm. The sol-gel process allows the preparation of porous glass materials with considerable compositional variation. Porous glasses may be prepared in powder form or as extrudable masses that demonstrate excellent thermal and mechanical stability. Variation of the glass composition, surface characteristics, and pore distribution of these materials can produce wide variety of water isotherm shapes. Porous glasses have been prepared from fifteen sol-gel formulations, and their adsorption isotherms have been measured for water vapor. Variations of dopants in the glasses have been made in order to achieve a Type-I isotherm exhibiting a separation variation in shape. Type-I isotherms were obtained for two of the materials, whereas others demonstrated a Type-IV isotherm. The heats of desorption for adsorbed water has been determined to be comparable to the heat of vaporization for pure water, and the materials have sufficient porosity to allow adequate mass transfer.

18449 (PB—88-155809/XAB) Fire-safety inspection and testing of air-moving systems. Klote, J.H. (National Bureau of Standards, Washington, DC (USA). Center for Fire Research). Nov 1987. 40p. (NBSIR—87/3660). NTIS, PC A03/MF A01.

This paper discusses fire-safety inspection and testing procedures for air-moving systems. These systems include heating, ventilating and air-conditioning systems; zoned smoke-control systems; and pressurized stairwells. The detailed methods for inspection and testing presented in the appendices are initial efforts in the evolution of such methodology and it is anticipated that users will modify them to suit their needs.

18450 (PB—88-855879/XAB) Heat pumps: industrial applications. April 1981-December 1987 (citations from the NTIS data base). Report for April 1981-December 1987. (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 66p. NTIS PC N01/MF N01.

This bibliography contains citations concerning design, development, and applications of heat pumps for industrial processes. Included are thermal energy exchanges based on air-to-air, ground-coupled, air-to-water, and water-to-water systems. Specific applications include industrial process heat, drying, district heating, and waste processing plants. Other published searches in this series cover heat-pump technology and economics, and heat pumps for residential and commercial applications. (Contains 122 citations fully indexed and including a title list.)

18451 (PB—88-855887/XAB) Heat pumps: residential and commercial applications. April 1981-December 1987 (citations from the NTIS data base). Report for April 1981-December 1987. (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 77p. NTIS PC N01/MF N01.

This bibliography contains citations concerning design, development, and applications of heat pumps for residential houses and apartments, and commercial applications, such as office buildings and greenhouses. Heat-pump energy exchanges are based on air-to-air, ground-coupled, air-to-water, and water-to-water systems. The citations cover costs and reliability of the heat-pump systems, and studies of operations in differing climates and seasons. Other published searches in this series cover heat pump technology and economics, and heat-pumps for industrial applications. (Contains 154 citations fully indexed and including a title list.)

18452 (PB—88-855903/XAB) Heat pumps: technology and economics. April 1981-December 1987 (citations from the NTIS data base). Report for April 1981-December 1987. (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 58p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the technology and evaluation of heat-pump systems and components. Evalua-

tion includes coefficient of performance and economics of various types of heat pumps and energy-exchange media for varying climatic or seasonal conditions. Solid state heat pumps are part of the new technology referenced in the citations. Heat-pump energy exchanges are based on air-to-air, ground-coupled, air-to-water, and water-to-water systems. Other published searches in this series cover heat pumps for residential and commercial applications, and heat pumps for industrial applications. (Contains 115 citations fully indexed and including a title list.)

18453 **Magnetic heat pump design.** Kirol, L.D.; Dacus, M.W. (Idaho National Engineering Lab., Idaho Falls, ID). pp 1133-1137 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—). Contract AC07-76ID01570.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879025.

Heat pumps utilizing the magnetocaloric effect offer a potentially attractive alternative to conventional heat pumps and refrigerators. Many physical configurations of magnetic heat pumps are possible. Major classes include those requiring electrical energy input and those with mechanical energy input. Mechanical energy is used to move magnets, working material, or magnetic shielding. Each type of mechanical magnetic heat pump can be built in a rotary (recuperative) or reciprocal (regenerative) configuration. Machines with electrical energy input utilize modulation of the magnetic field to cause working material to execute the desired thermodynamic cycle, and can also be recurperative or regenerative. Recuperative rotary heat pumps in which working material is moved past stationary magnets is the preferred configuration. Regenerative devices suffer performance degradation from temperature change of regenerator material and mixing and conduction in the regenerator. Field modulated cycles are not practical due to ac losses in superconducting magnets. Development of methods for recuperator fluid pumping is the major challenge in design of rotary recuperative devices. Several pumping options are presented, and the design of a bench scale heat pump described.

18454 **(AIVC-TN—19) 1986 survey of current research into air infiltration and related air quality problems in buildings.** Charlesworth, P. (Air Infiltration and Ventilation Centre, Bracknell (UK)). Dec 1986. 112p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751766/JAW.

The Air Infiltration and Ventilation Centre's world wide survey of current research into air infiltration and related topics, provides organisations in participating countries with regularly updated information about ongoing research in this field. In particular, the major objectives of the survey are to encourage the international cross-fertilization of research ideas and to promote co-operation between research organisations in different countries. This, the fourth survey, is based on summaries received from researchers following the distribution of a standardized survey form to organisations thought likely to be involved in air infiltration/air quality research.

18455 **(CONF-870853—3-FP) Air velocities inside domestic environments: An important parameter in the study of indoor air quality and climate.** Matthews, T.G.; Thompson, C.V.; Wilson, D.L.; Hawthorne, A.R.; Mage, D.T. (Oak Ridge National Lab., TN (USA); Environmental Protection Agency, Research Triangle Park, NC (USA)). 1987. Contract AC05-84OR21400. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004331/JAW.

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Air velocities have been measured in the master bedroom, kitchen, and basement of six occupied homes plus the dining/living room area of one unoccupied house. All of the houses have central, forced-air heating and air conditioning (HVAC) systems. Median air velocities of 5.3 and 12.4 cm/s were measured in all six occupied houses and the unoccupied house, respectively. Median velocities of 4.2, 4.3, and 10.2 cm/s were found in the master bedroom, basement, and kitchen of the six occupied homes, respectively. The elevated air velocities in the kitchen are consistent with increased occupant activities and use of ceiling and/or exhaust fans. The lowest median velocity of 1.1 cm/s was found in the master bedroom (with the forced air circulation off) where occupant entry and activities were purposely limited. Switching on the forced-air HVAC systems increased the median velocities from 5.8 to 6.2, 3.2 to 5.7, 1.5 to 8.1, and 4.4 to 15.5 cm/s in three occupied houses one unoccupied house, respectively, where the experimental data allowed such comparison. Low air velocities may sometimes be inadequate for quantitative passive monitoring of pollutant vapors. Ten and 50% reductions in sampling rate are noted from the literature for passive monitors at air velocities of <0.7-25 cm/s and <0.7-2 cm/sec, respectively. 14 refs., 6 figs.

18456 **(CONF-871203—1) An in-situ evaluation of the settling of loose-fill rockwool insulation in the attics of two manufactured home units.** Graves, R.S.; Yarbrough, D.W. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003395/JAW.

From Conference on insulation materials, testing and applications; Bal Harbour, FL, USA (6 Dec 1987).

The effect of vibrations due to manufacturing and transport on the thickness, density, and calculated thermal resistance (R-value) of loose-fill rock wool insulation installed in two manufactured home units has been determined. Thickness and density measurements on blown attic insulation were made after installation, at the end of the manufacturing process, and after the units were towed 265 miles. These measurements were used to calculate R-values for the attic insulation. The end sections of the two units showed an overall insulation thickness decrease of about 16% and an average R-value change from 31.2 to 28.8 $ft^2.h.^\circ F/Btu$. An estimated R-value greater than 30 $ftc^2.h.^\circ F/Btu$ resulted from averaging the end and middle sections of the two units. The effect of reduced thickness along the edges of the attic space was not included in the estimate. 8 refs., 2 figs., 1 tab.

18457 **(DOE/CE/63445—T1) Support services for the Weatherization Assistance Program opportunity grants: Final technical report.** (DAC International, Inc., Washington, DC (USA)). 15 Nov 1987. Contract AC01-85CE63445. 453p. NTIS, PC A20. Order Number DE88005362/JAW.

The Energy-Related Business Development Project was designed by the US Department of Energy Weatherization Assistance Program (DOE/WAP) to promote activities which demonstrate strategies for providing weatherization services without Federal Funds or which promote energy-related business development activities. In December 1985, 38 community action agencies were selected through a competition grant process to participate in this demonstration project. The purpose of this project was to provide training and technical assistance to the selected grantees - to help them develop skills in business development through the identification and evaluation of potential and existing local agency energy-related ventures. This project provided support for grantees to research and package energy-related business plans capable of receiving outside financing.

18458 **(EPRI-EM—5530) Workshop proceedings: Opportunities to improve indoor environments of commercial buildings.** (Whiddon (W.I.) and Associates, Inc., Winchester, VA (USA); Hart, McMurphy and Parks, Inc., Middleburg, VA (USA)). Dec 1987. 30p. (CONF-8703227—Summ.). NTIS, PC A03/MF A01; 1 - Research Reports Center, Box 50490, Palo Alto, CA 94303; GPO Dep. Order Number DE88003840/JAW.

From Workshop on opportunities to improve indoor environments of commercial buildings; Palo Alto, CA, USA (24 Mar 1987).

This workshop identifies opportunities and determines research needs to improve commercial building indoor environments. Attendees included representatives of commercial building owners, designers and engineers, environmental equipment and controls manufacturers, indoor air quality researchers, and electric utilities. Presentations were given on research needs from the perspective of each of these industry segments. Working groups recommended twelve research and development activities that could lead to de-

velopment of equipment and controls for improving commercial building indoor environments.

18459 **(LBL—18020) Thermal mass: A comparison of measurements and blast predictions for six test cells in two climates.** Carroll, W.L.; Mertol, A.; Sullivan, R. (Lawrence Berkeley Lab., CA (USA)). Jan 1987. Contract AC03-76SF00098;AC05-84OR21400. 97p. (ORNL/Sub—83-70373/2). NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88004503/JAW.

This report contains the results of the comparison of BLAST (Building Loads Analysis and System Thermodynamics) predictions and measured data from three experimental test cells at each of two field sites operated by the New Mexico Research and Development Institute and the US National Bureau of Standards, respectively. For each cell, comparisons were made for three simulation time periods representing different seasonal conditions; each of the comparison periods was about ten days in length. For each of these time periods, hourly comparisons were made for ten selected parameters: heating or cooling load, air temperature, and individual wall inside surface temperatures and heat fluxes. Statistical descriptions of the comparison results are summarized in tables. Time-series plots showing comparisons of selected measured and predicted parameters are also presented. During the simulation studies a number of issues have been identified and discussed in detail to explain the observed differences between the measured data and the BLAST predictions. These differences are generally within a range explainable by a combination of the measurement uncertainties, where they are quantifiable, and by unavoidable input assumption variances in the simulation compared to actual experimental conditions. Finally, the ability of BLAST to predict load changes among the cells due to climate or thermal mass is discussed. 19 refs., 54 figs., 27 tabs.

18460 **(LBL—19681) Thermal mass: BLAST residential parametric simulations: Final report.** Carroll, W.L.; Sullivan, R.; Mertol, A. (Lawrence Berkeley Lab., CA (USA)). Jan 1987. Contract AC03-76SF00098;AC05-84OR21400. 105p. (ORNL/Sub—83-70373/1). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88004498/JAW.

This report documents an effort to determine the effect of exterior-wall thermal mass on the annual heating and cooling loads of a typical 1200 ft/sup 2/ three-bedroom residence. The effects were determined using Building Loads Analysis and Systems Thermodynamics (BLAST) simulations for an extensive set of parametric variations of exterior wall thermal mass configurations. Simulations were conducted for six different climatic conditions representing the full range of conditions found in the continental US. Three hundred and thirteen simulations were performed for each climate. The complete simulation results are presented as a tabular data base. Several important aspects of behavior were observed in the data: (1) increasing the wall thermal mass always reduces both the heating and cooling loads, (2) changes in the loads due to incremental changes in the exterior wall's thermal resistance or thermal mass varies widely, (3) importance of exterior wall mass for reducing heating loads is strongly dependent on climate, (4) for walls with thermally massive layers, the loads changed when the position of the insulation and massive layers were interchanged, and (5) loads were lower when the insulation layer was outside the mass layer. A non-linear empirical model that represents the energy use results as a function of wall thermal mass and thermal resistance was developed. Using this model, least squares fits to the data were carried out separately for heating and cooling loads, for each of the generic wall types, in each climate. The resulting regression coefficients are presented in tabular form. In general, the agreement between the model predictions and the data is quite good. In another part of the effort, selected architectural, engineering, and building use assumptions were varied to determine their effect on the wall thermal mass energy impacts for a limited number of wall configurations. 22 refs., 11 figs., 7 tabs.

18461 **(ORNL/Sub—85-00294/1) Building envelope thermal anomaly analysis.** Melton, B.S.; Mulroney, P.; Scott, T.; Childs, K.W. (VVKR, Inc., Alexandria, VA (USA)). 1 Dec 1987. Contract AC05-84OR21400. 71p. NTIS, PC A04/MFA 01; 1; GPO Dep. Order Number DE88006056/JAW.

A detailed study has been made of building energy thermal anomalies (BETA's) in a large modern office building using computer simulation, on-site inspections, and infrared thermography. The goal was to better understand the heat and moisture flow through these "bridges," develop the beginnings of a classification scheme, and establish techniques for assessing the potential for retrofit or initial design modifications. In terms of presently available analytical techniques, a one-dimensional equivalent of the bridge and its affected area can be created from a steady-state computer simulation. This equivalent, combined with a degree day model, yields good estimates of the bridge behavior in buildings employing heating only. With heating and cooling, the equivalent must be used with an hour-by-hour simulation. A classification scheme based on the one-dimensional equivalent is proposed which should make it possible to create a catalog of basic bridge types that can be used to estimate their effects without requiring a complete hour-by-hour simulation of each building. The classification relates both energy loss and moisture condensation potential to the bridge configuration and the building envelope. The potential for moisture condensation on interior surfaces near a BETA was found to be as significant as the energy loss and this factor needds to be considered in assessing the complete detrimental effects of a bridge. With such a catalog, building designers and analysts would be able to determine and estimate the advantages or disadvantages of modifying the building envelope to reduce the impact of a thermal bridge. 18 refs., 31 figs., 17 tabs.

18462 **(ORNL/Sub—86-55951/1) Applicability of aerospace thermal insulation technologies to the civilian sector: Final report.** Fine, H.A. (Kentucky Univ., Lexington (USA). Dept. of Metallurgical Engineering and Materials Science). Oct 1987. Contract AC05-84OR21400. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88003717/JAW.

The thermal insulation-related technology developed and documented in past research and development programs in aerospace and other federally-funded programs and the international community, was identified and located using the NASA/RECON system and through personal contacts to facilitate technology transfer. In addition, the literature was reviewed to identify specific concepts that seemed to have the potential for substantial energy conservation and which fit into the ECUT mission. These concepts were separated into the following catagories: fibrous insulation materials, evacuated microsphere insulation, multi-layer insulation, other insulation concepts, coatings, transport models, measurement technology, and patent literature. Citations to the pertinent literature and suggestions for future research are presented. 39 refs.

18463 **(PB—88-126727/XAB) Model test of air-exchange efficiency.** Klobut, K. (Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning). 1987. 52p. (B—14). NTIS, PC E04/MF A01.

The mixing-air flow pattern was studied. Three air flows were tested using the tracer gas technique and decay method. The indices of air exchange efficiency were calculated, namely: overall air-exchange efficiency and room-air mean age for the whole room; local ventilation indices and local mean ages of air at 10 points distributed throughout the room. Experiments were carried out in both isothermal and nonisothermal conditions. Based on the theory of similarity requirements, a reduced-scale model, geometrically similar to the laboratory test room, was built. Air flows and temperature differences were calculated for the model tests in order to make them comparable with the full scale, and the tests were repeated. The objective of the study was to determine the relation between the air-exchange efficiency indices obtained in the model and on the full scale.

18464 **(PB—88-129036/XAB) Heat gain through a curtain wall with windows and an external glass facade.** Johannsen, A. (Council for Scientific and Industrial Research, Pretoria (South Africa). National Mechanical Engineering Research Inst.). 1986. 11p. (CSIR-ME—499). NTIS, PC E04/MF E04.

In recent years, a number of office buildings have been constructed in South Africa featuring a light-weight external wall with

windows and an additional all-glass external facade. In this paper, a computer program is described to compute the cooling and heating loads of buildings with an external construction such as that described above. In addition, results are presented of an analysis, with the aid of the program, of a number of variations in the design of the external construction of a hypothetical building in order to indicate trends in the magnitude of the cooling and heating loads resulting from such variations in design. An attempt is also made to present simplified methods for estimating the cooling loads of the above construction for those designers who do not as yet use computers in their design work. The program is based on a mathematical model describing the main heat transfer paths in the external construction, including the conective and radiative heat exchange and natural-ventilation cooling.

18465 **(PB—88-155882/XAB) Method for measuring the effectiveness of gaseous-contaminant-removal devices. Progress report.** Mahajan, B.M. (National Bureau of Standards, Washington, DC (USA). Building Environment Div.). Sep 1987. 22p. (NBSIR—87/3666). NTIS, PC A03/MF A01.

This progress report briefly describes the test apparatus designed for measuring the effectiveness of filter media, various components of the test loop, instrumentation, and contaminant-concentration-measuring techniques. The report also describes various aspects of the planned testing scheme that will be followed to accomplish the goals of the research project.

18466 **Sunlighting, daylighting, and passive solar heating for earth covered dwellings.** Boyer, L.L.; Grondzik, W.T. (Texas A & M Univ., College Station). pp 220-223 of Advances in geotectural design. Boyer, L.L. (ed.). College Station, TX; Texas A & M University (1986). (CONF-860640—).

From 2. international earth-sheltered buildings conference - advances in geotechnical design; Minneapolis, MN, USA (15 Jun 1986).

Much has been written about passive solar heating, and the daylighting topic has also received attention. Much less has been said about earth sheltered structures, although there appears to be widespread interest in this topic. However, the deliberate combination of good daylighting, sunlighting, and passive solar heating as incorporated into an earth sheltered building has scarcely been addressed. The purpose of this work is to delineate the critical features of each of the above building attributes, and to show by example analysis how to properly achieve the desired integration of all the major facets involved. In addition to the performance aspects of each attribute, the aesthetic, functional, and structural implications are also considered. The above work has been developed from research and professional conference activities organized and conducted by the authors with funding support from Oklahoma State University, Control Data Corporation, and the US Department of Energy. 6 references, 4 figures, 2 tables.

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REFER ALSO TO CITATION(S) 18423, 19106

18467 **(PB—88-128616/XAB) Transit marketing: successes and failures. Final report.** Oram, R.L. (National Research Council, Washington, DC (USA). Transportation Research Board). Sep 1987. 36p. (TRB/NCTRP/SYN—12). NTIS, PC A03/MF A01.

Report on National Cooperative Transit Research and Development Program, Synthesis of Transit Practice. Library of Congress catalog card No. 87-50688.

The synthesis will be of interest to transit planners, administrators, and others in the transit field who are concerned with the marketing of transit services. Information is presented on transit-marketing programs that have been successful and on some that were not successful. Transit agencies have tried many different types of marketing programs to increase ridership or revenue or to improve operations; these have met with varying degrees of success. The report of the Transportation Research Board describes several of these programs and gives general indication of why some are more successful than others.

18468 **(EUR—285) Non-contacting fluid ring seal systems for railcar axle bearing systems: Quarterly progress report No. 2, September 16 to December 15, 1987.** (Ernst Mechanical Industries, Old Saybrook, CT (USA)). 1987. Contract FG01-87CE15334. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003676/JAW.

Progress in fluid-ring seal design, test rig design, and manufacturing is given.

18469 **(DOE/OR/21400—H5) The Motor Fuel Consumption model thirteenth periodical report.** (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). Jan 1988. Contract AC05-84OR21400. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88005866/JAW.

This document is the thirteenth of a series of periodic reports on the Motor Fuel Consumption (MFC) model developed for the Department of Energy (DOE). The MFC model is used by DOE to evaluate the impact of conservation policies on fuel consumption and on the disaggregate components of fuel demand. These components include passenger cars, light-duty trucks, and heavy-duty vehicles. The model is not a forecasting tool in that it does not provide detailed econometrically based projections of fuel demand. The model is, however, calibrated to current statistics on fuel consumption, fleet size, and travel growth, and to econometric forecasts of new vehicle sales provided by DOE. During the past year and a half (October 1985 to April 1987), the MFC model has been used to evaluate the consumption impacts of revised projections of light duty truck Corporate Average Fuel Economy (CAFE). In addition, the model has been used to support analyses of: (1) the potential market for neat methanol fuels; and (2) the fuel consumption impacts of reductions in vehicle stock turnover. The purpose of this report is to provide the reader with the most current output of the Motor Fuel Consumption Model and to discuss revisions in the model structure, input data and assumptions which have occurred in the past year. 43 refs., 3 figs., 18 tabs.

18470 **(DOE/OR/21400—H7) Fuel purchasing patterns and vehicle use trends from the NPD Research Gasoline Diary Data Base: October 1983-September 1984, Data display.** (Energy and Environmental Analysis, Inc., Arlington, VA (USA)). Jan 1988. Contract AC05-84OR21400. 118p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005874/JAW.

This report tabulates basic summaries of data on fuel consumption, on-road fuel economy and vehicle miles of travel for the twelve month period October 1983 through September 1984. 2 refs.

18471 **(ORNL/Sub—85-22007/2) A guide to the planning and management of vehicle fleet tests to obtain significant results.** Bechtold, R.L. (Mueller Associates, Inc., Baltimore, MD (USA)). Feb 1988. Contract AC05-84OR21400. 78p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88006153/JAW.

A guide is presented for the successful planning and execution of vehicle fleet tests to obtain valid and statistically significant results. The typical pitfalls of fleet tests are discussed and methods of avoiding them are offered. Management structure and approach is presented. Data collection methods are characterized with respect to the equipment (and its cost) required and the effect on fleet operations. Quality control measures for the data are offered. Various statistical analysis methods are described in relation to analysis of the results and for planning purposes. Data storage and presentation methods are outlined with respect to avoiding errors and minimizing effort. The component costs of operating a fleet test are estimated so that total costs for a specific fleet can be predicted.

18472 **(PB—88-128582/XAB) Development and use of mathematical models in motor-vehicle policy analysis - 1987.** Richardson, B.C. (Richardson Associates, Inc., Ann Arbor, MI (USA)). Aug 1987. 30p. (RAI—87-102). NTIS, PC A03/MF A01.

See also PB—86-245222, and PB—88-128590.

The report presents information on the recent development and use of mathematical models in the motor vehicle policy process. Federal agencies involved in such model development and use

include the U.S. Departments of Commerce, Energy, and Transportation and the U.S. Environmental Protection Agency. Mathematical model development and use in the motor vehicle policy process appears to have decreased over the last decade. Recently developed models at the Department of Commerce include an automotive parts and accessories model, an industrial performance model, and an accounting model. Models of the Department of Energy include the Technology Cost Segment Model, a motor fuel consumption model, the Transportation Energy Demand Model, the Transportation Energy and Emissions Modeling System, and several models under development. The Department of Transportation is sponsoring the development of a vehicle miles of travel model. The Environmental Protection Agency is involved in the development and use of a wide range of models including MOBILE3, MOBILE3-Fuel Consumption Model, and the National Exposure Model.

18473 **(PB—88-128590/XAB) Inventory of selected mathematical models relating to the motor-vehicle transportation system and associated literature. Fifth supplement.** Richardson, B.C. (Richardson Associates, Inc., Ann Arbor, MI (USA)). Aug 1987. 104p. (RAI—87-101). NTIS, PC A06/MF A01.

See also PB—86-245230, and PB—88-128582.

The volume contains abstracts of selected mathematical models relating to the motor vehicle transportation system and of literature related to the subject matter or objectives of the models. This is a supplement to five earlier volumes that contain descriptions of 289 models and 252 associated documents. The volume contains descriptions of 37 additional models and 26 associated documents. The purpose of the report is to present abstracts of policy-oriented models of the motor-vehicle transportation system and related model literature. Included is a set of indexes that can be used to locate particular models or documents according to five different categories: report title, keyword, personal author, performing organization, and sponsor.

18474 **(PB—88-129135/XAB) Study of alternative transportation strategies during reconstruction of the Parkway East, I-376, Pittsburgh, Pennsylvania.** (GAI Consultants, Inc., Monroeville, PA (USA)). Mar 1983. 496p. NTIS, PC E99.

Set includes PB—88-129143 through PB—88-129184.

A separate abstract was prepared for each of the five parts of this set.

18475 **(PB—88-129143/XAB) Study of alternative transportation strategies during reconstruction of the Parkway East, I-376, Pittsburgh, Pennsylvania. Executive summary. Final report, January 1981-January 1983.** Anderson, R.B.; Hendrickson, C.T. (GAI Consultants, Inc., Monroeville, PA (USA)). Mar 1983. 28p. (REPT—81-118-ES). NTIS, PC A03/MF A01.

See also PB—88-129150; Also available in set of 5 reports PC E99, PB—88-129135.

To reduce negative effects of congestion delays and adverse community impacts, several people-moving strategies were implemented: a new commuter train, third-party van-pool program, high occupancy vehicle (HOV) ramps, new park-and-ride lots, new express bus service, and traffic operation improvements on local streets. Study of these alternative transportation strategies included pre-, during- and post-construction measurements of traffic characteristics, strategy usage, and user responses; an evaluation of strategy effectiveness; and suggestions for applications to future projects. The report presents the results of the second-year study, and discusses the use of alternative strategies, panel-survey results, and strategy effectiveness.

18476 **(PB—88-129150/XAB) Study of alternative transportation strategies during reconstruction of the Parkway East, I-376, Pittsburgh, Pennsylvania. Report on the second reconstruction season. Report for March 1982-July 1983.** Anderson, R.B.; Hendrickson, C.T.; Janson, B.; Kundrat, D.F.; Taylor, L.R. (GAI Consultants, Inc., Monroeville, PA (USA)). Jul 1983. 71p. (REPT—81-118-2). NTIS, PC A04/MF A01.

See also Executive Summary, PB—88-129143, and Appendix 1, PB—88-129168; Also available in set of 5 reports PC E99, PB—88-129135.

To reduce negative effects of congestion delays and adverse community impacts, several people-moving strategies were implemented. The report presents the results of the second-year study, and discusses the use of alternative strategies, panel-survey results and strategy effectiveness.

18477 **(PB—88-129168/XAB) Study of alternative transportation strategies during reconstruction of the Parkway East, I-376, Pittsburgh, Pennsylvania. Appendix 1. Traffic characteristics. Final report, January 1981-January 1983.** Anderson, R.B.; Kundrat, D.F.; Mack, R.J.; Taylor, L.R. (GAI Consultants, Inc., Monroeville, PA (USA)). Mar 1983. 219p. (REPT—81-118-APP-1). NTIS, PC A10/MF A01.

See also PB—88-129150, and Appendix 2, PB—88-129176; Also available in set of 5 reports PC E99, PB—88-129135.

To reduce negative effects of congestion delays and adverse community impacts, several people-moving strategies were implemented. Appendix I describes the affected highway/street network, construction-induced traffic restrictions and traffic operation improvements; and results of an extensive data-collection program performed before, during, and after the first-year construction phase, to determine corridor traffic volumes, vehicle occupancy/classification, and travel times on the Parkway and other alternate routes.

18478 **(PB—88-129176/XAB) Study of alternative transportation strategies during reconstruction of the Parkway East, I-376, Pittsburgh, Pennsylvania. Appendix 2. Corridor traveler surveys. Final report, January 1981-January 1983.** Hendrickson, C.T.; Dubyak, T.; McNeil, S. (GAI Consultants, Inc., Monroeville, PA (USA)). Mar 1983. 68p. (REPT—81-118-APP-2). NTIS, PC A04/MF A01.

See also Appendix 1, PB—88-129168, and Appendix 3, PB—88-129184; Also available in set of 5 reports PC E99, PB—88-129135.

To reduce negative effects of congestion delays and adverse community impacts, several people-moving strategies were implemented. Appendix II describes the methodology used to survey Parkway Corridor users, presents the initial and follow-up surveys of a traveler panel, and discusses the panel responses to reduced capacity of the Parkway and the strategies for mitigating travel impacts.

18479 **(PB—88-129184/XAB) Study of alternative transportation strategies during reconstruction of the Parkway East, I-376, Pittsburgh, Pennsylvania. Appendix 3. Shared-ride travel strategies. Final report, January 1981-January 1983.** Anderson, R.B.; Hendrickson, C.T.; Kundrat, D.F.; Taylor, L.R.; Janson, B.N. (GAI Consultants, Inc., Monroeville, PA (USA)). Mar 1983. 110p. (REPT—81-118-APP-3). NTIS, PC A06/MF A01.

See also Appendix 2, PB—88-129176; Also available in set of 5 reports PC E99, PB—88-129135.

To reduce negative effects of congestion delays and adverse community impacts, several people-moving strategies were implemented. Appendix III describes the methodology and results of data collection surveys for shared-mode strategies. The appendix exhibits data collected on each strategy, with particular emphasis on data used in the main report to assess the cost-effectiveness of each.

18480 **Transportation energy demand from 1980 to 2010: Structure and results of the transportation energy and emissions modeling system.** Vyas, A.; Millar, M.; Patterson, P. (Center for Transportation Research, Argonne National Lab., Argonne, IL 60439). pp 263-268 of Applied simulation and modeling. Koval, D.O. Anaheim, CA; Acta Press (1986). (CONF-8606112—).

From IASTED modelling and simulation conference; Vancouver, Canada (4 Jun 1986).

As part of ongoing work for the U.S. Department of Energy (DOE), Argonne National Laboratory's Center for Transportation Research develops detailed forecasts of U.S. transportation energy

demand, by mode and fuel type. These forecasts are generated by a model system of linked component modules of local personal travel demand, intercity travel demand, and goods movement. The local personal travel component uses an iterative proportional fitting technique to project household characteristics by several demographic variables and an incremental logit model to predict changes in household vehicle holdings. The intercity travel module is a network-based, direct demand formulation based on utility-maximizing principles. The freight module is driven by econometric forecasts of sectoral output. Mode shares are determined by sampling a series of probability-density functions of shipment attributes and shipper preferences. Major inputs include exogeneous economic, demographic, and price assumptions; outputs include long-range model and submodal forecasts of transportation stock, activity, and energy demand. This paper documents the methodology and presents selected results from the latest run of the model system.

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REFER ALSO TO CITATION(S) 18026, 18400, 18421, 18423

18481 (CONF-870762—1) Overview of the DOE-ECUT Tribology Program. Nichols, F.A.; Michaels, A.I. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002878/JAW.

From Coatings for advanced heat engines workshop; Castine, ME, USA (27 Jul 1987).

This paper describes the ECUT Tribology Program which seeks to provide the base technology required to achieve savings in US annual energy consumption by means of major tribological advances. This may be achieved through direct energy savings, by increasing efficiency or productivity, or through savings of the energy embodied in materials and devices by reducing wear. The mission also seeks to reduce the significant limitations in the operation of existing and advanced tribological systems which have to operate in severe environments such as high temperature, high speeds, high loads, corrosive gases and liquids and combinations thereof. The ECUT Tribology Program has established close ties with US industry and universities to determine current and future needs for advances of tribological systems and to facilitate the transfer of any new technology which is developed within the program.

18482 (DOE/ID—10176) Techno-economic assessment of electric steelmaking through the year 2000. Bosley, J.J.; Clark, J.P.; Dancy, T.E.; Fruehan, R.J.; McIntyre, E.H. (Steelcon, Inc., Pittsburgh, PA (USA); Carnegie-Mellon Univ., Pittsburgh, PA (USA). Center for Metals Production). Jul 1987. Contract AC07-76ID01570. 204p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88003227/JAW.

This paper presents a critical review of the outlook for electric steelmaking including an assessment of existing and potential electric arc furnace (EAF) capacity. Suggested areas of development to minimize energy consumption and optimize output are also featured. 20 figs.; 62 tabs.

18483 (DOE/NBM—8002773) Research and development separation technology: The DOE Industrial Energy Conservation Program. (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Industrial Programs). Jul 1987. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002773/JAW.

This brochure summarizes the Office of Industrial Programs' R&D efforts in the advancement of separation technology. The purpose of this brochure is to provide interested parties with information on federal industrial energy conservation activities in separation technology. The brochure is comprised of the following sections: Separation Technology, summarizes the current state of separation technology and its uses. Potential Energy Savings, discusses the potential for industrial energy conservation through the implementation of advanced separation processes. Office of Industrial Programs' R&D Efforts in Separation Technology Development, describes the separation R&D projects conducted by IP. R&D Data Base, lists contractor, principal investigator, and location of each separation-related R&D effort sponsored by IP.

18484 (DOE/NBM—8005775) Research and development in the textile industry. (USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC. Office of Industrial Programs). Jun 1987. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005775/JAW.

Included in the portfolio of IP's projects are the R & D activities for several advanced technologies targeted at the textile industry, one of the top ten energy intensive industries in the country. These R & D projects have primarily been aimed at improving the energy efficiency and productivity of textile production processes. Many projects in this area have been successfully completed, and some have resulted in the development and implementation of new technologies (e.g., foam processing) for various process steps. Other projects have produced technical results that have later been utilized by the industry in other capacities (e.g., hyperfiltration). Several projects at various stages of development are currently underway. This brochure describes the Office of Industrial Programs' R & D activities relevant to the textile industry. The brochure is comprised of the following: Industry Update, Energy Consumption in the Textile Industry, Energy Consumption in the Textile Industry, Potential Energy Savings in the Textile Industry, Office of Industrial Programs, R & D Efforts, and R & D Data Base.

18485 (DOE/RL/01830—T55) The US steel industry: An energy perspective. Azimi, S.A.; Lowitt, H.E. (Energetics, Inc., Columbia, MD (USA)). Jan 1988. Contract AC06-76RL01830. 157p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88005313/JAW.

This report investigates the state of the US steel industry in terms of energy consumption and conservation. The specific objectives were: to update and verify energy and materials consumption data at the various process levels in 1983; to determine the potential energy savings attainable with current (1983), state-of-the-art, and future production practices and technologies (2000); and to identify new areas of research and development opportunity that will enable these potential future savings to be achieved. The results of this study concluded that in year 2000, there is a potential to save between 40% and 46% of the energy used in current production practices, dependent on the projected technology mix. R & D needs and opportunities were identified for the industry. Potential R & D candidates for DOE involvement with the private sector were assessed and selected from the identified list.

18486 (NP—8770040) Development of high productive technology for vegetables. Performance of a test plant and experiments of spinach cultivation. Sekiyama, Tetsuo; Okano, Toshiaki; Hoshi, Takehiko; Kosakai, Kazuyoshi; Okabe, Katsumi; Hanyu, Hiromichi. (Central Research Inst. of Electric Power Industry, Abiko, Chiba (Japan). Bio-Environment Lab.). Feb 1987. 57p. (In Japanese). NTIS (US Sales Only), PC A04. Order Number DE88770040/JAW.

Technology of a system using both sunlight and artificial light was developed, and a vegetable plant with the system was developed to study the use of low-cost off-peak electricity for the improvement of vegetable productivity and quality. A test plant of 340m^2 was constructed. The greenhouse was designed in a pellette house style where light is controlled through grains of styrofoam by blowing. To use low-cost offpeak electricity, heat reservoir facility for cold (ice) and hot water was provided. An environment measuring system was provided for the analysis of the relationship between the environmental conditions, growth of vegetables and consumption of electricity. Four cultivation experiments were carried out, and the yield of spinach increased by 6 to 7 times (10 kg/m^2) in summer season, and the period of growth in winter time was shortened to 1/2 to 1/3 (25 days). Results of the study on the performance of the facilities such as cultivation room, light environment, CO_2 environment, hydroponic device, etc. are also reported. (32 figs, 5 tabs)

18487 (PNL-SA—14740) INDUST: An industrial data base. Wilfert, G.L.; Moore, N.L. (Pacific Northwest Lab., Richland, WA (USA)). Jul 1987. Contract AC06-76RL01830. 9p. (CONF-8709166—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003416/JAW.

From 9. annual industrial energy technology conference; College Station, TX, USA (16 Sep 1987).

INDUST is a data base of energy flow information for the thirteen most energy-intense industrial groups within the manufacturing sector. Within each industry group, INDUST contains data on plants, processeds, equipment, and technology. The energy-use data in INDUST is continually being updated with the latest data from the Energy Information Administration (EIA). The EIA reports fuel consumption according to six categories: electricity, fuel oil, natural gas, coal and coke, and other fuels. INDUST can be used for many types of analyses. This paper discusses INDUST's structure and capabilities and one example analysis that helps the industrial sector forecast its electricity demands. 2 refs., 3 figs., 2 tabs.

18488 (CE-Trans—8284) Utilisation of fibre products in the construction of ceramic kilns. Brachet, P. Translated from *Silicates Industriels ;* No. 9-10, 127-131(1986). 14p. NTIS, PC A03/MF A01. Order Number DE88900288/JAW.

Ceramic fiber products are being increasingly used for the lining of industrial kilns, particularly in the ceramics industry, which needs to combine energy conservation and intermittent use of kilns. Silica-alumina fibers are ideal. Apparent density, thermal conductivity, and $\sqrt{\lambda}$/rho are compared for insulating bricks and fiber products. Fiber products have an open porosity >85%, which means that the kiln atmosphere penetrates the lining, leading to corrosion problems. The construction and performance of a ceramic kiln are described. 3 figs. (DLC)

18489 (CONF-880128—3) A model of an ammonia-water falling film absorber. Perez-Blanco, H. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004477/JAW.

From ASHRAE winter meeting; Dallas, TX, USA (30 Jan 1988).

This paper describes a model of the absorption process in a falling film ammonia-water absorber. The model consists of two ordinary, first-order differential equations with suitable inlet and interface conditions. The model was validated by comparing its predictions to experimental data. The objective of the work was to define strategies to enhance the absorption process in order to downsize absorbers. It was found that in most situations of practical interest, the mass transfer process in the falling film controls the absorption rate. The possibility of water evaporation and migration in the absorber is discussed, outlining how it can degrade performance. 16 refs., 5 figs., 4 tabs.

18490 (EUR—11193) Steam drying of beet pulp: Demonstration project: Final report, 1 July 1983-30 April 1986. (Danske Sukkerfabrikker A/S, Copenhagen). 1987. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900365/JAW.

The objective of the project is to develop a drying plant for beet pulp and other products, the drying of which can take place within a closed system with circulating overheated steam which keeps the material to be dried moving in a fluidized bed. Steam can be drained from the system to be utilized for other purposes. In this way, it is possible to save energy. In addition to the energy saving, the method will reduce the impact on the environment, and in comparison with other traditional methods of drying, the product quality will be improved. 3 refs., 9 figs.

18491 (NZERDC—145) Industrial electric motors and controllers: Final report. (Worley Consultants Ltd., Auckland (New Zealand)). Jun 1987. 151p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88900357/JAW.

This report sets out to determine the scope for energy savings to be made through the more efficient use of the electrical energy consumed by 400-volt, 3-phase asynchronous induction motors within New Zealand industry. The report examines the energy performances of 'standard' and 'high efficiency' motors together with the ranges of solid state controllers, and the part they can play in achieving savings. The investigation identified a number of additional reasons for considering energy conservation investments. These include: (1) electricity costs in general are increasing at a faster rate than motor prices, (2) in the case studies average motor loadings were only 64% of full load current, (3) oversizing of motors occurs on a large scale, leading to lower efficiencies and poorer power factors than optimum. It has been established that 'efficiency' is rarely a factor considered when evaluating motors, but it has been demonstrated that energy conservation measures in relation to motor selection can provide very good economic returns along with other benefits. The report concludes that there is considerable scope for energy savings to be made, and that the measures that may be taken to achieve these savings are economically viable. Finally recommendations are made for implementation of an energy conservation programme targeted at industrial motor users. 16 refs.

18492 (NP—8751947) Investigation of long time stability on a working fluid for industrial ORC-plants. Final report. Bormann, H.; Bosse, J.; Eynatten, C. von; Fuerst, P.; Heine, G.; Rasche, H.H. (Kali-Chemie A.G., Hannover (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Oct 1986. 63p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751947/JAW.

The refrigerant Kaltron 11, which is used in an existing industrial ORC-plant with a piston-type steam engine and power-heat-coupling, has been studied with regard to its thermal stability. There were special interests in: long time behavior of the working medium, treatment and maintenance of the working medium, effects of lubricating oil, criterions of plant components layout, operating optimization. The trials were executed under normal operation conditions. The course of the studies was handicapped by a plant defect before the beginning of this project and by the existing limiting conditions of the waste heat delivery from a calcining kiln. After all the ORC-plant had to be modified and rebuilt within this project, based on the knowledge of the falling out defects. According to the thermal long time stability of K11 there resulted a large dependence on water content in the working fluid. With fluid temperatures higher than 120degC a water content below 1 ppm has to be required. Specially selected adsorption drying medium and lubricating oil directly had no negative influence on the working fluid stability, but disadvantageous effects at decomposition of the working medium were concentrated. Construction and operation of some plant components could be improved with regard to the working fluid stability. ORC-plant operation with high temperature at the stability limit of K11 improves power generation, but simultaneously the expense for a satisfactory plant availability must increase rapidly. With 5 refs., 35 figs..

18493 (NYSERDA—87-28) Demonstration of a long-life radiant recuperator for the secondary aluminum industry: Final report. (TECOGEN, Inc., Waltham, MA (USA)). Dec 1987. 72p. New York State Energy Research and Development Authority, Two Rockefeller Plaza, Albany, NY 12223. Order Number TI88900381/JAW.

Large savings can be obtained by recovering heat from flue gas of industrial furnaces and using it to preheat the combustion air. However, there are service life and fouling problems. A gas-to-gas heat exchanger (recuperator) has been developed whose service life should exceed the amortization period. This recuperator was tested to demonstrate its performance and determine its fouling characteristics and service life in harsh industrial environments. The test furnace was an open hearth reverberatory aluminum remelt furnace, at Roth Brothers Smelting Corp. in East Syracuse, NY. The recuperators' performance was monitored over six months. The furnace was operated at several firing rates and flue gas temperatures to bracket recuperator performance. Production and fuel use data were collected. The system was instrumented for flow, pressure, and temperature measurement. Finally, coupon samples of liner material were suspended in flue gas near the recuperators' exhaust for data on corrosion rates. The recuperators performed well. Combustion

air preheat temperatures of 850°F were recorded for the design point firing rate, with a flue gas temperature of 1900°F. The service life was estimated to be 2.9 years. Fuel savings under normal operation varied from 13 to 40%, depending on the specific firing schedule. The recuperators required no regular maintenance after initial adjustments. Visual examination of the liners after five months of operation revealed no areas of excessive corrosion. Calculated fuel savings based on the baseline furnace performance were $84,900 for the first six months, which would easily pay for the recuperator and installation costs in under 1.5 years. Both recuperators were still in service in midyear 1987 after nearly two years of operation. Repair of the end seal was required because of excessive leakage.

18494 **(DOE/CE/15299—T1) Development of a liquid jet for disintegration of organic and inorganic materials: Final technical report, September 15, 1986-September 14, 1987.** Mazurkiewicz, M. (Incubator Technologies, Inc., Rolla, MO (USA)). Nov 1987. Contract FG01-86CE15299. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003813/JAW.

The work completed for this project includes the development of three working prototypes for disintegration of materials and the testing of the systems to determine performance characteristics. The material used was waste newsprint, books and fiberboard. This report describes the systems tested, the method of testing and presents results of the testing. 8 figs., 2 tabs. (JDH)

18495 **(DOE/CS/40341—T6) Conceptual design of a black liquor gasification pilot plant.** Kelleher, E.G. (Champion International Corp., West Nyack, NY (USA)). Aug 1987. Contract AC05-80CS40341. 94p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88003621/JAW.

In July 1985, Champion International completed a study of kraft black liquor gasification and use of the product gases in a combined cycle cogeneration system based on gas turbines. That study indicated that gasification had high potential as an alternative to recovery boiler technology and offered many advantages. This paper describes the design of the plant, the construction of the pilot plant, and finally presents data from operation of the plant.

18496 **(PB—88-126412/XAB) Hazardous-waste combustion in industrial processes: cement and lime kilns.** Mournighan, R.E.; Branscome, M. (Research Triangle Inst., Research Triangle Park, NC (USA)). Nov 1987. 76p. NTIS, PC A05/MF A01.

This report summarizes the results of several studies relating to hazardous-waste combustion in cement and lime kilns. The tests included in the study are four kilns tested by the U.S. Environmental Protection Agency, four kilns tested by State agencies or the kiln operator, two Canadian tests, and one Swedish test. The predominant types of wastes tested included chlorinated organic compounds, aromatic compounds, and metal-contaminated waste oil. The kiln types include lime kilns and cement kilns, which included the dry, wet, and preheated processes. Fabric filters and electrostatic precipitators (ESPs) were the pollution-control devices used in these processes, and the primary fuels included coal, coke, coal/coke, fuel oil, and natural gas/coke. The parameters examined in the report were Destruction and Removal Efficiency (DRE) of the Principal Organic Hazardous Constitutents, particulate and HCl emissions, metals, and the effect of burning hazardous waste on SO_2, NOx, and CO emissions. The primary conclusion of the study is that DRE's of 99.99% or greater can be obtained in properly-operated calcining kilns. Particulate matter can increase when chlorinated wastes are burned in a kiln equipped with an electrostatic precipitator. Those kilns equipped with fabric filters showed no change in emissions.

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REFER ALSO TO CITATION(S) 18163, 18189, 18190, 18368, 18494

18497 **(ANL—87-49) Screening and degradation tests of linear-polymer additives for district heating applications.** Choi, U.S.; Cho, Y.I.; Kasza, K.E. (Argonne National Lab., IL (USA)). Dec 1987. Contract W-31109-ENG-38. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005892/JAW.

In closed-loop district heating and cooling (DHC) systems, the addition of a friction-reducing additive to the working fluid conveying energy between the energy sources and end users would allow increased load-handling capability (in an existing system) or the use of much smaller pipes and/or pumps (in a new system). As the first step in identifying friction-reducing additives that have a reasonable lifetime at DHC tempratures, two high-molecular-weight linear-polymer additives have been tested at two different temperatures (25.0°C and 87.8°C). The additives are Polyox WSR-301 and Separan AP-273 at 200 wppm in deionized water. Results of capillary tube screening tests with fresh solutions show that both polymers can give more than 60% friction reduction. However, Separan is effective at high temperatures, whereas Polyox undergoes thermal degradation. Degradation tests in a closed recirculatory flow system show that (1) friction reduction is always accompanied by heat transfer reduction regardless of the hours of shear, (2) Polyox cannot be uwsed in recirculatory systems because it is very sensitive to mechanical degradation, and (3) although Separan does degrade under high flow shear conditions, it does not degrade completely; it achieves a plateau value of friction reduction even under conditnuous shear. This is an important discovery and implies that Separan is still a good candidate for closed-loop DH systems. 36 refs., 12 figs., 1 tab.

18498 **(ANL/CNSV—63) State laws and regulations affecting development and renovation of district heating and cooling systems.** Kier, P.H.; Meshenberg, M.J. (Argonne National Lab., IL (USA)). Sep 1987. Contract W-31109-ENG-38. 122p. NTIS, PC A06/MF A01; GPO Dep. Order Number DE88005895/JAW.

This study of how state legislation affects development and renovation of district heating and cooling (DHC) systems has two focal points: for investor-owned systems, it examines public utility regulation, while for publicly owned systems, it looks at local government law. Statutes and case law were studied, and officials of several DHC systems were contacted, to identify problems imposed by the legal and regulatory framework and to learn how these problems can be resolved through changes in either the DHC systems or the statutes. Many private developers of DHC systems prefer to avoid regulation of their systems as public utilities and might be deterred by uncertainty as to whether they provide a regulated commodity and service to the public. Further, public-entity participation in DHC systems might be deterred in some states by lack of express statutory authority and by limitations on borrowing and on duration and types of contracts the systems can enter into. The study revealed 50 recent pieces of legislation that encourage or facilitate DHC systems (and that indicate problems and potential solutions). The content of this legislation was then used to construct drafts of two model statutes. The first - related to public utility regulation - adopts the limited-regulation approach of three western states in eliminating the most burdensome aspects of such regulation, including traditional rate regulation, while protecting customers. The second model statute - related to local government law - allows joint formation of DHC authorities by local government. 33 refs., 12 tabs.

18499 **(DOE/CE/26528—T1) Onondaga County district heating and cooling system: Technical and economic assessment: Final report.** (Resource Development Associates, Inc., Dayton, OH (USA)). Jun 1987. Contract FG01-85CE26528. 154p. NTIS, PC A08; 3; GPO Dep. Order Number DE88004257/JAW.

The purpose of the work conducted under this contract was to identify and configure district heating and cooling system development opportunities in downtown Syracuse, Onondaga County,

New York. In order to accomplish this work, a four-part methdology was employed. In the first part, the annual heating consumption in the downtown was identified and calculated. Selected buildings were surveyed, and typical energy use profiles were developed. In the second part, development opportunities and influences were identified. Development opportunities were evaluated within the context of the energy use patterns in the downtown. Early-start systems that could be economically developed to serve the loads in the development areas were identified in the third part. The fourth part involved developing interest for the early-start systems, and establishing long term strategy for system growth and expansion. In Onondaga County, a steam and chilled water system with expansion capability was identified and recommended for development. 8 figs., 12 tabs.

18500 **(ORNL/CON—220) A review of utility conservation programs for the commercial building sector.** Kolb, J.O.; Hubbard, M.S. (Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 102p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88006142/JAW.

This report presents the results of a survey of conservation program activities conducted by 26 public utilities in the commercial building sector. The purpose of the survey was to provide an information data base on utility-sponsored conservation programs planned or in progress for the commercial building sector. This data base is to be used by the Department of Energy (DOE) to define conservation programs that assist and complement utility conservation programs. Information on four types of conservation programs was solicited: financial incentive programs, energy service programs, rate research and incentive programs, and case studies and demonstration studies. The approach used in selecting the utilities to be surveyed is described. The results of the utility survey are summarized in terms of the following characteristics: type of program, program history, marketing strategies, program motivation, system load effects and goals, and evaluation activities, active or planned. Six utility programs are recommended as candidates for commercial program "case studies" for the DOE on the basis of the data obtained in this survey. 7 refs.

18501 **(PB—88-153721/XAB) Calculations of maximum allowable heat losses for various shallow-trench heat-distribution systems.** Fang, J.B. (National Bureau of Standards, Washington, DC (USA). Building Environment Div.). Nov 1987. 119p. (NBSIR—87/3617). NTIS, PC A06/MF A01.

The calculation of heat losses for shallow-trench underground heat-distribution systems was performed using a finite=element computer program. The finite-element analysis solved a two-dimensional steady-state heat-transfer problem for two insulated pipes in a rectangular trench with surrounding soil. A life-cycle-cost analysis was performed to determine the cost of construction and annual energy cost associated with pipe heat loss for underground concrete trench systems of different trench dimensions and insulated-pipe sizes.

18502 **(PNL—5931) Load management alternatives to transmission and distribution construction: Toledo-Wren case study.** Englin, J.E.; Klan, M.S.; Lyke, A.J.; Tawil, J.J.; De Steese, J.G.; Tepel, R.C. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1987. Contract AC06-76RL01830. 100p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE88004669/JAW.

This paper describes the development of a method to predict the feasibility of using load management as an alternative to construction of transmission and distribution capacity. A forecasting model was developed and applied to a particular case. Several problems were identified in the test case, necessitating modification of the model. The authors conclude that the modified version of the model allows accurate assessment of the effects of load management and conservation measures on transmission capacity. 13 figs. (JDH)

18503 **(ANL/CNSV—62) Pyrolysis of municipal solid waste: Annual report, July 1985-June 1986.** Helt, J.E.; Agrawal, R.K.; Myles, K.M. (Argonne National Lab., IL (USA)). Oct 1987. Contract W-31109-ENG-38. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005784/JAW.

The pyrolysis of municipal solid waste (MSW) is a promising method of producing useful fuels. Current research sponsored by the Department of Energy at Argonne National Laboratory is directed toward gaining an improved understanding of the basic thermokinetic mechanisms associated with the pyrolytic conversion of MSW. Results from nonisothermal and isothermal bench-scale experiments of some MSW components are presented. Feedstocks included not only individual components but also mixtures of components. The effects of heating rate and sample size on overall degradation and product formation over the temperature range 300-475°C are discussed. Some preliminary higher-temperature runs (up to 700°C) were completed in preparation for future work in the gasification regime. Work also continued on the characterization of the liquids produced during the pyrolysis process. 32 refs., 24 figs., 16 tabs.

18504 **(PB—88-127931/XAB) Characterization of MWC (municipal waste combustion) ashes and leachates from MSW (municipal solid waste) landfills, monofills, and co-disposal sites.** (NUS Corp., Pittsburgh, PA (USA)). Oct 1987. 1073p. NTIS, PC E99.

Set includes PB—88-127949 through PB—88-128004.

This set contains the report that summarizes the results of five other reports that compile extensive reviews of available literature and data on municipal waste combustion (MWC) ash and leachate. In addition, the report provides chemical characterization data on MWC ash and simulated leachates as well as data on chemical parameters of actual leachate collected from municipal-waste landfills, monofills, and co-disposal sites. The report includes the results of these analyses and a limited number of conclusions and recommendations for future actions. The Agency intends to utilize the document in the development of a viable ash management strategy. The set also contains the additional six support volumes to the report.

18505 **(PB—88-127949/XAB) Characterization of MWC (municipal waste combustion) ashes and leachates from MSW (municipal solid waste) landfills, monofills, and co-disposal sites. Volume 1. Summary. Final report.** (NUS Corp., Pittsburgh, PA (USA)). Oct 1987. 145p. (R—33-6-7-1). NTIS, PC A07/MF A01.

See also Volume 2, PB—88-127956; Also available in set of 7 reports PC E99, PB—88-127931.

This report summarizes the results of five other reports that compile extensive reviews of available literature and data on municipal waste combustion (MWC) ash and leachate. In addition, the report provides chemical characterization data on MWC ash and simulated leachates as well as data on chemical parameters of actual leachate collected from municipal-waste landfills, monofills, and co-disposal sites. The report includes the results of these analyses and a limited number of conclusions and recommendations for future actions. The Agency intends to utilize the document in the development of a viable ash management strategy.

18506 **(PB—88-127956/XAB) Characterization of MWC (municipal waste combustion) ashes and leachates from MSW (municipal solid waste) landfills, monofills, and co-disposal sites. Volume 2. Leachate baseline report: determination of municipal landfill leachate characteristics.** (NUS Corp., Pittsburgh, PA (USA)). Oct 1987. 132p. (D—33-10-6-17). NTIS, PC A07/MF A01.

See also Volume 1, PB—88-127949 and Volume 3, PB—88-127964; Portions of this document are not fully legible; Also available in set of 7 reports PC E99, PB—88-127931.

This volume contains the results of a literature survey on the environmental effects of municipal waste-disposal sites.

18507 **(PB—88-127964/XAB) Characterization of MWC (municipal waste combustion) ashes and leachates from MSW (municipal solid waste) landfills, monofills, and co-disposal sites. Volume 3. Addendum to characterization of municipal landfill leachates--a literature review. Final report.** (NUS Corp., Pittsburgh, PA (USA)). Oct 1987. 41p. (D—33-3-7-10). NTIS, PC A03/MF A01.

See also Volume 2, PB—88-127956 and Volume 4, PB—88-127972; Portions of this document are not fully legible; Also available in set of 7 reports PC E99, PB—88-127931.

This volume contains additional literature review data on the environmental effects of municipal waste-disposal sites.

18508 **(PB—88-127972/XAB) Characterization of MWC (municipal waste combustion) ashes and leachates from MSW (municipal solid waste) landfills, monofills, and co-disposal sites. Volume 4. Characterization of municipal waste combustion residues and their leachates--a literature review. Final report.** (NUS Corp., Pittsburgh, PA (USA)). Oct 1987. 106p. (D—33-5-7-20-VOL-4). NTIS, PC A06/MF A01.

See also Volume 3, PB—88-127964 and Volume 5, PB—88-127980; Also available in set of 7 reports PC E99, PB—88-127931.

This volume contains the results of a literature review of the environmental effects of municipal-waste-combustion residues and their leachates.

18509 **(PB—88-127980/XAB) Characterization of MWC (municipal waste combustion) ashes and leachates from MSW (municipal solid waste) landfills, monofills, and co-disposal sites. Volume 5. Characterization of municipal-waste-combustor residues. Draft report (Final).** (NUS Corp., Pittsburgh, PA (USA)). Oct 1987. 295p. NTIS, PC A13/MF A01.

See also Volume 4, PB—88-127972, and Volume 6, PB—88-127998; Portions of this document are not fully legible; Also available in set of 7 reports PC E99, PB—88-127931.

This volume details the results of a field and analytical program to investigate municipal combustor residues at four ash monofills, including ash, field leachate, simulated leachates, quench waters, and ground water.

18510 **(PB—88-127998/XAB) Characterization of MWC (municipal waste combustion) ashes and leachates from MSW (municipal solid waste) landfills, monofills, and co-disposal sites. Volume 6. Characterization of leachates from municipal-waste-disposal sites and co-disposal sites. Final report.** (NUS Corp., Pittsburgh, PA (USA)). Oct 1987. 333p. (D—33-5-7-21-VOL-6). NTIS, PC A15/MF A01.

See also Volume 5, PB—88-127980 and Volume 7, PB—88-128004; Portions of this document are not fully legible; Also available in set of 7 reports PC E99, PB—88-127931.

This volume contains the results of a field and analytical program to characterize leachates from four municipal waste-disposal sites and two co-disposal sites.

18511 **(PB—88-128004/XAB) Characterization of MWC (municipal waste combustion) ashes and leachates from MSW (municipal solid waste) landfills, monofills, and co-disposal sites. Volume 7. Addendum to monofill report. Final report.** (NUS Corp., Pittsburgh, PA (USA)). Oct 1987. 23p. (D—33-5-7-21-VOL-7). NTIS, PC A03/MF A01.

See also Volume 6, PB—88-127998; Also available in set of 7 reports PC E99, PB—88-127931.

This volume details the additional field-investigation activities conducted at the four ash monofills in which analyses for selected conventional parameters from leachate samples were completed.

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 18424, 18427, 18462

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

18512 **(ANL/MCT—87-2) Description of data from the reversing flow test facility.** Roach, P.D. (Argonne National Lab., IL (USA). Materials and Components Technology Div.). Nov 1987. Contract W-31109-ENG-38. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004836/JAW.

To date, more than 100 data sets have been acquired from the Reversing Flow Test Facility (RFTF), which is part of the heat engine R and D activities at Argonne National Laboratory (ANL) to develop efficient alternative engines. One of the major goals of the RFTF project is to make all data available to researchers outside of ANL. To help researchers decide if and how they can use the data, this report describes the accumulated data sets in detail. The data sets are described as they are stored on the HP-1000 computer at ANL, and as they are transmitted as ASCII text by means of Fortran formatted write statements. The data are divided into static data, which give data set identification, acquisition date, values of steady-state pressures and temperatures, and other useful values; and dynamic data, which give the values of up to 128 time-dependent variables as a function of time and crank angle, and include transducer data such as temperature and pressure, and derived data such as mass flow and enthalpy flux. Parameters such as Reynolds number, Valensi number, amplitude ratio, and regenerator effectiveness, which are not included in the data sets, are discussed briefly. The data sets are avialable on magnetic tape, floppy disk, Softstrip on paper, and printed on paper. 1 ref., 5 figs.

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 17892, 18520, 18520

18513 **A one hundred watt sodium heat engine.** Lasecki, J.V.; Novak, R.F.; Mc Bride, J.R.; Brockway, J.T.; Hunt, T.K. (Ford Motor Co., Dearborn, MI 48121). pp 1408-1415 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—).

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879381.

The Sodium Heat Engine (SHE) is a device that converts heat directly to electricity. Since SHE losses scale directly with output, efficiency can be essentially independent of size, and SHE units should be suitable for modular assembly into large systems. Because of their potential for high specific power, efficiency (25 - 35%), and low maintenance, they are candidates for a wide variety of thermal to electrical energy conversion tasks. Among these are industrial cogeneration, space nuclear power generation, and solar thermal 'dish electric' conversion. The authors report progress in an experimental program directed toward an improved understanding of the scale-up properties of SHE systems and their performance as a function of temperature and design configuration. SHE systems have been successfully tested over a range of hot-side, operating temperatures between 600 and 800°C, and at electrical output power levels above 100 watts. The design tested in these experiments uses radiative coupling between a 'hot-wall' thermal source and the active SHE conversion elements. A one hundred watt test system has operated successfully from a combustion heat source using a natural gas/air combustor in a central heater well. System design considerations and the temperature operating limits are also discussed.

18514 **(PB—88-136247/XAB) Electronic control system for gasoline engines.** Sasaki, T.; Tada, Y.; Ueda, A. (Mitsubishi Electric Corp., Tokyo (Japan)). 1987. 6p. NTIS, PC E05.

Text in Japanese; Included in Mitsubishi Denki Giho, Vol. 61, No. 8, 65-70(1987).

An electronic control system for a multipoint fuel-injection system was developed and commercially produced for use in vehicles manufactured by Mitsubishi Motors. The system's sensors include a proprietary Karman vortex-type airflow sensor and an optical crank-angle sensor. In addition to fuel metering, the microcomputer-based system controls the spark timing and engine idle speed and performs diagnostic functions.

18515 **(AD-A—186136/8/XAB) Low noise catalytic ignition IC engine. Final report.** (Pfellerle (William C.) Associates, Middletown, NJ (USA)). 1987. 43p. NTIS MF A01.

Availability: Microfiche copies only.

A prototype catalytic ignition internal combustion engine using diesel fuel was evaluated and experimentally tested for potential beneficial effects in reducing engine noise. Experimental results

produced a total sound-pressure improvement in the 4 - 5 dB range. Noise reductions were even larger in the speech frequency and high human-sensitivity ranges. Literature research and theoretical advancements indicate the potential for a larger noise reduction as well as a confirmation that the reduction, resulting from a reduction in combustion noise, would be additive with most other conventional sound improvement technologies. Independent of noise-reduction potential, the catalytic ignition technology also shows strong potential to produce significant improvements in fuel economy, power, cold start capabilities, pollutant emissions and multifuel capability (both in terms of improved fuel quality insensitivity and an ability to utilize low or zero cetane fuels). Early prototypes of the catalytic ignition engine have been fabricated by modifying an existing diesel engine, and it is believed that commercial production of a fully-developed catalytic ignition engine would involve relatively little redesign and retooling from existing diesel production. Cost of a commercial catalytic engine is estimated to be low ($10 to $40 per cylinder above existing diesel engines) and a retrofit capability has been demonstrated.

18516 **(ANL/CNSV—60) Integrated Rankine bottoming cycle for diesel truck engines.** Sekar, R.; Cole, R.L. (Argonne National Lab., IL (USA)). Sep 1987. Contract W-31109-ENG-38. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005318/JAW.

This study assessed the feasibility of incorporating a Rankine bottoming cycle into a diesel truck engine. An organic Rankine bottoming cycle (ORBC) previously demonstrated by the US Department of Energy in a heavy-duty, long-haul truck reduced the truck's fuel consumption by about 12%. However, that system was considered too complex and costly to be commercialized. The integrated Rankine bottoming cycle (IRBC) described here is expected to be simpler and less costly than the ORBC. In the IRBC, one cylinder of a six-cylinder diesel truck engine will be used for power recovery, instead of the turbine and reduction gears of the ORBC; engine coolant will serve as the working fluid; and the engine radiator will also serve as the condenser. Toluene and steam were considered as working fluids in this assessment, and we concluded that steam (at 1000 psi, partially vaporized to about 33% saturation in the cylinder head, and superheated in an evaporator) would be the more practical of the two. Both heat exchangers are smaller than those of the ORBC system, but may pose a challenge in an under-the-hood installation. Overall, the concept appears feasible. 13 refs., 9 figs., 7 tabs.

18517 **(PB—88-855580/XAB) Two stroke engines. June 1970-December 1987 (citations from the Engineering Index data base). Report for June 1970-December 1987.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 71p. NTIS PC N01/MF N01.

Supersedes PB—87-850293.

This bibliography contains citations concerning the operating characteristics, performance, and applications of two-stroke cycle internal combustion engines. Topics include fuel injection, lubrication, and exhaust systems as well as emission control. Marine, motorcycle, and diesel engines are included. Factors contributing to engine noise are also discussed. (This updated bibliography contains 168 citations, 15 of which are new entries to the previous edition.)

18518 **(DOE/NASA/50111—1) Combustion characteristics of gas turbine alternative fuels.** Rollbuhler, R.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. Contract AI01-85CE50111. 20p. (NASA-TM—100247; CONF-8710116—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004235/JAW.

From 25. automotive technology development contractor's coordination meeting; Dearborn, MI, USA (26 Oct 1987).

An experimental investigation, cosponsored by the Department of Energy and NASA, was conducted to obtain combustion performance values for specific heavy-end, synthetic hydrocarbon fuels. A flame tube combustor modified to duplicate an advanced gas turbine engine combustor was used for the tests. Each fuel was tested at steady-state operating conditions over a range of mass flow rates, fuel-to-air mass ratio, and inlet air temperatures. The combustion pressure, as well as the hardware, were kept nearly constant over the program tests phase. Test results were obtained in regards to geometric temperature pattern factors as a function of combustor wall temperatures, the combustion gas temperature, and the combustion emissions, both as affected by the mass flow rate and fuel-to-air ratio. The synthetic fuels were reacted in the combustor such that for most tests their performance was as good, if not better, than the baseline gasoline or diesel fuel tests. The only detrimental effects were that at high inlet air temperature conditions, fuel decomposition occurred in the fuel atomizing nozzle passages resulting in blockage. And the nitrogen oxide emissions were above EPA limits at low flow rate and high operating temperature conditions. 4 refs., 16 figs., 1 tab.

18519 **(GB—111) Fuel saving. Is waste heat the answer.** Plumb, C.M.; King, R.H. (University Coll., London (UK)). 1986. 12p. NTIS (US Sales Only), PC A03. Order Number DE88751765/JAW.

During the design of a new warship, it is important to examine many features of the ship's performance and costs. However, before a ship design can be progressed very far, information on particular features must be made available at a time when much of the design will be unknown or poorly defined. The required information must therefore be produced, if not in total isolation from other design aspects, at least well removed from them. It is in this environment that the merits of fuel saving using the heat in the exhaust gas from the propulsion gas turbines to generate steam which is expanded in a steam turbine and forms a combined gas and steam propulsion system (COGAS*) were approached.

3302 External Combustion Engines

REFER ALSO TO CITATION(S) 18519

18520 **(DOE/NASA/50112—71) Coatings for high-temperature bearings and seals.** Sliney, H.E. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. Contract AI01-85CE50112. 14p. (NASA-TM—100249; CONF-870762—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004241/JAW.

From Coatings for advanced heat engines workshop; Castine, ME, USA (27 Jul 1987).

Criteria are discussed for predicting the probable lubricating ability of candidate solid materials from a consideration of their basic chemical and physical properties. The properties considered to be of importance in the model are thermochemical potential, adhesion, low hardness, plasticity, yield strength in shear, and brittle-to-ductile transition characteristics. A review of the selection and tribological testing of materials, which were selected for use in self-lubricating composite coatings by employing this model, is given. Two series of plasma-sprayed coatings with good tribological properties over a wide temperature spectrum are described. The PS 100 series of coatings contain oxidatively stable solid lubricants in a nichrome matrix. The PS 200 series contains the same solid lubricants in a very wear resistant metal-bonded chromium carbide matrix. Examples are given of applications of these coatings in high speed shaft seals, sliding contact bearings, and Stirling engine cylinder liners. 9 refs., 19 figs., 1 tab.

18521 (NP—8770039, pp 382-408) **Research and development of general purpose stirling engine.** Terada, Fusao. (Tokyo, Sanyo Electric Co., Ltd., Tokyo, Japan). 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

To answer the general expectation for a practical production of stirling engine, which is highly efficient and silent, a 30 kW stirling engine for a small drive power was developed. Basic target was to achieve a level of 30 kW with efficiency of 37% (using hydrogen) by the end of fiscal 1987, and the actual result obtained at the end of 1985 was a maximum output 33.5 kW and a maximum efficiency 30%. The prototype produced in 1985 is called NS30S, and while it is of a standard structure, it has the featuring points of a free selectivity of the combination of bore and stroke and a high-speed rotation, a high gas-charging pressure, large output per

engine weight, flawless drive unit, horizontal shaft ejection for an easy connection with the load, and so forth. (26 figs, 9 tabs)

18522 (NP—8770044, pp 352-379) **Reseach and development of stirling engine for wide use. Development of 30 KW class stirling engine for air-conditioning (NS 30A).** Kondo, Tadashi. (Aisin Seiki Co. Ltd., Aichi, Japan). 21 Sep 1984. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

In Proceedings of parallel sessions for the 4th NEDO general assembly.

This research has been continued since 1982 based upon the NEDO basic project. The following knowledge and results were obtained; 1) Research of sealing technology; Concerning material to be used, Riflon 320 showed a good result in abrasion tests. From the results of gas leak tests and performance deterioration tests, intermediate scraper seals were provided between scraper seals and oil seals. 2) Research of stoking equipment technology; Due to the development of an air-fuel ratio setting apparatus, a ratio between air-flow and fuel-flow could almost be stabilized. With regard to the material for burner tiles and flame protecting boards of stirling engine, Si3N4, the surface of which is coated with material of low expansibility was found to be most suitable. 3) Others; Having selected heat-resisting materials and tested their durability, Hastelloy XR showed excellent anti-corrosiveness for both pipes and castings. (26 figs, 18 tabs)

18523 (NP—8770045, pp 417-444) **Reserch and development of general purpose stirling engine.** Sakamoto, Moriyoshi. (Toshiba Corporation, Tokyo, Japan). 20 Sep 1985. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770045/JAW.

In Proceedings of parallel sessions for the 5th NEDO general assembly.

This research was carried out as one of the studies funded by NEDO. A heat pump driven by a stirling engine with a high efficiency and a low vibratory noise is considered as meeting expectations as an energy saving air conditioner suitable for a densely populated residential quarter, and has been developed mainly in U. S. In this country also, the unit has been developed since 1982 as a stirling engine for general purposes, and the immediate target is to realize an engine with an output of 3KW and an efficiency of 32% and a heat pump driven by the engine and capable of developing the performance coefficients of 0.92 for cooling and 1.49 for heating respectively by 1987. As a design condition, helium gas was selected for the working gas, and the helium sealed in the cylinder and the crank chamber at 6Mpa by the engine revolution of 1 500 r.p.m. was heated to 650. On element technologies, the seal technology, heat exchanger, burner, output draw-out technology were studied, and an engine for trial production was designed and manufactured. (28 figs, 2 tabs)

18524 **Degradation of the organic rankine-cycle fluid RC-1.** Ragaller, D.; Sibert, L.; Cole, R.L.; Demirgian, J.C.; Allen, J.W. (Sundstrand Aviation Operations, Rockford, IL). pp 1396-1401 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—).

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879074.

This paper describes static capsule tests of the fluid RC-1 at 800, 900, and 1000°F, the analytical methods used to analyze thermal degradation of the RC-1, and the test results. The primary mechanism of degradation is polymerization, which liberates fluorine gas (F/sub 2/) and hydrogen fluoride (HF). These gaseous degradation products further break down the RC-1 and its degradation products. Operation of an organic Rankine-cycle engine with RC-1 at the test temperatures would be difficult.

18525 **Predicting toluene degradation in organic rankine-cycle engines.** Cole, R.L.; Demirgian, J.C.; Allen, J.W. (Argonne National Lab., Argonne, IL). pp 1402-1407 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—). Contract W-31-109-ENG-38.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879075.

This paper describes the measurement of toluene degradation in dynamic loop tests that simulate operation of an organic Rankine-cycle engine. Major degradation products and degradation mechanisms are identified, and degradation is quantified. Results indicate that toluene is a stable fluid with benign degradation products, provided that oxygen is excluded from the engine. A means of predicting degradation in the engine is developed.

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 18330, 18346

18526 **(DOE/CE—0148-Rev.1) Mission directed goals for electric vehicle battery research and development: The Task Force on electric vehicle battery goals.** (EG and G Idaho, Inc., Idaho Falls (USA)). Nov 1987. Contract AC07-76ID01570. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005601/JAW.

This report on the Department of Energy (DOE) mission directed goals for electric vehicle battery research and development is a revision and update of report DOE/CE-0148. The original report was prepared by the Task Force on Electric Vehicle Battery Goals and published by the Electric and Hybrid Propulsion (EHP) Division of the Office of Transportation Systems. The EHP Division of the DOE formed the Task Force on Electric Vehicle Battery Goals to evaluate existing EV battery R and D goals and to recommend new battery goals targeted at the urban van mission. The original report (DOE/CE-0148) was distributed to government and industry for review and comment. After consolidation of the comments, each comment was considered in the context of the project scope. INEL edited and published this document as the final report on the efforts of the Task Force on Electric Vehicle-Battery Goals. To the extent possible within the original scope of the project, the comments of government and industry are incorporated herein. This report will be updated periodically as results from current research, both federally and privately supported, become available.

18527 **(EGG-EP—7541) Performance test results for the Eaton dc developmental power train in an electric test bed vehicle.** Crumley, R.L.; Donaldson, M.R. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1987. Contract AC07-76ID01570. 163p. NTIS, PC A08. Order Number DE88005458/JAW.

This report presents the results of the tests performed on a direct current (dc) power train in a test bed vehicle developed by the Eaton Corporation for the US Department of Energy (DOE). The tests were performed by EG & G Idaho, Inc. at the Idaho National Engineering Laboratory (INEL). The purpose of the INEL testing was to provide test results from which an evaluation of the performance capabilities of the Eaton dc power train could be made and compared with other vehicle propulsion systems. The planned tests were primarily oriented toward road testing, chassis dynamometer testing, and associated dynamometer coastdown tests for road loss determination. Range tests of the Eaton dc test bed vehicle using an ALCO 2200 lead acid battery pack, produced ranges of 97 km at 56 km/h (60 miles at 35 mph), 79 km at 72 km/h (49 miles at 45 mph), and 47 km at 88 km/h (29 miles at 55 mph). The corresponding net dc energy consumptions are 135 Wh/km (217 Wh/mile), 145 Wh/km (233 Wh/mile), and 178 Wh/km (287 Wh/mile). The energy consumption for the D-cycle test was 241 Wh/km (387 Wh/mile). 8 refs., 11 figs., 16 tabs.

18528 **(EPRI-EM—5553) Evaluation of near-term electric vehicle battery systems through in-vehicle testing: Second annual final report.** Blickwedel, T.W.; Whitehead, G.D.; Thomas, W.A. (Tennessee Valley Authority, Chattanooga (USA)). Dec 1987. 237p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920142/JAW.

This report documents the performance from October 1985 through September 1986 of the Tennessee Valley Authority's ongoing project to evaluate near-term electric vehicle traction batteries. This second annual report includes the addition of four new batteries and the termination of two sets. The purpose of this field test activity is to provide an impartial evaluation and comparison of battery performance in a real-world operating environment. Testing includes initial acceptance testing of battery components and systems, daily in-vehicle operation of the batteries, monthly in-vehicle driving range tests, and periodic static (constant current) discharge tests under computer control. Battery performance data is typically presented on the basis of specific energy versus accumulated vehicle mileage and vehicle driving range over fixed operating cycle (35 mi/h) constant speed (SAE J227a "C" Cycle). Data is analyzed statistically with variable conditions normalized. The life-cycle is terminated when a battery system's measured capacity drops below 60 percent of rating (at the 2-hour rate) and/or after 25 percent of the battery modules have been replaced. 120 figs., 2 tabs.

18529 **(EUR—10908) Development of a total electric vehicle drive system: Final report.** Walker, D. (Chloride Legg Ltd., Wolverhampton (UK)). 1986. 163p. NTIS (US Sales Only), PC A08. Order Number DE88900367/JAW.

The original purpose of this project was to develop a total vehicle control system incorporating a high frequency power supply for both battery charging and motor field control for battery powered traffic compatible electric road vehicles. By 1982 it was realized this aim could not be realized due to suitable semiconductors not being introduced by the manufacturers as soon as anticipated. The project then took the form of the separate development of an electric vehicle controller, a dc-dc converter and and off-board high frequency charger. Considerable operating experience was obtained with each of these products undergoing continuing improvements. Both the controller and the converter went through two major redesigns (Mark I and Mark II). This report describes in detail, the evolution of the three designs, the principles of operation, testing, specification and revisions, and details the major circuit innovations. The bulk of the performance and reliability testing was carried out on complete vehicles which prolonged the data gathering exercise due to vehicle failures not connected with the project components. The relevant vehicle reliability reports are included in the Appendix. At the end of the project, a drive system of good performance, high efficiency and high reliability was produced. Production of the vehicle on which the project was based was, unfortunately, stopped in 1985 due to lack of orders. The data and experience obtained from this development now form a basis for current and future development projects and an integrated system will be produced in the next year for production in 1988. 6 refs., 57 figs.

18530 **(GB—114) Hybrid electric vehicles.** Bumby, J.R.; Clarke, P.H. (Durham Univ. (UK)). 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751768/JAW.

In May 1982 the University of Durham began a project to evaluate the feasibility of hybrid electric vehicles. The broad aim of the project was to see if a hybrid electric vehicle could in some way, help reduce the dependency of the road transport sector on petroleum based fuels. To evaluate the benefits to be obtained from hybrid vehicles computer simulation of the vehicles performance over standard driving cycles was used. The development of such a road vehicle simulation computer program was to be part of the project.

3304 Hybrid Systems

18531 **Fuel cell/battery hybrid power source for vehicles.** Patil, P.G.; Huff, J.R. (Electric and Hybrid Propulsion Div., Office of Transportation Systems, U.S. Dept. of Energy, Washington, DC). pp 993-998 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—).

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879083.

Fuel cells can potentially provide the advantages of an ICE in a power system, but with clean and quiet operation. Because a fuel cell will deliver power as long as fuel and air are supplied, the range is limited only by the amount of fuel carried. The system may be limited in its ability to respond to severe load transients because of the thermal inertia of the fuel processing system. For this reason and because of improvements in battery performance over the past several years, a fuel cell/battery hybrid power source feasibility study was carried out based on phosphoric acid fuel cells in conjunction with advanced battery technologies. Fuel cells and batteries complement each other for the electric propulsion automotive application, providing long range, peak acceleration power, and recharge capabilities. Because of the power densities available with present phosphoric acid fuel cells, it is desirable to match the fuel cell to the average power requirement rather than to the peak power. Currently available fuel processors (reformers) are not designed for the rapid changes in fuel requirements needed for acceleration, therefore, the batteries must be capable of high-peak currents. The Department of Energy has carried out an intensive study of the fuel cell/battery hybrid requirements for vehicle applications. Results of this hybrid assessment are presented.

3306 Vehicle Design Factors

18532 **(CONF-8710116—2) Dynamic tensile cyclic fatigue of Si_3N_4.** Liu, K.C.; Brinkman, C.R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 10p. NTIS, PC A02. Order Number DE88003919/JAW.

From 25. automotive technology development contractor's coordination meeting; Dearborn, MI, USA (26 Oct 1987).

A series of tensile fast fracture and dynamic tension-tension cyclic fatigue tests were performed on a commercial grade of sintered silicon nitride at elevated temperatures above 1000°C. Small amounts of plasticity were observed when this material was cycled under tension-tension loading at 1200°C. Because of the plasticity, the fatigue behavior at 1200°C was found to be more complex compared to that at lower temperatures. Further, studies of the fatigue behavior showed that this material may be strain hardened slightly, such that increasing the cycling load via multiple step loading with intermittent cycling, i.e., coaxing resulted in increased fatigue life under certain conditions. An alternate explanation is that at elevated temperatures, some localized recrystallization may occur, thereby strengthening the material and increasing the fatigue life. The fracture surfaces of test specimens were examined using optical and scanning electron microscopy techniques to determine fracture origin and modes. These examinations have shown that all fractures were initiated at internal flaws, suggesting that the equipment and test methods are reliable and the data are indicative of material performance. 4 refs., 8 figs., 1 tab.

18533 **(CONF-8710116—4) Ceramic technology for advanced heat engines program data base.** Booker, M.K. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003922/JAW.

From 25. automotive technology development contractor's coordination meeting; Dearborn, MI, USA (26 Oct 1987).

A large amount and wide variety of data on the behavior of advanced ceramic materials is currently being generated within the Ceramic Technology for Advanced Heat Engines Program. This paper summarizes efforts to date to develop a computer data base system for the management of those data. The system is based on the use of desktop microcomputers, which provides a maximum of

efficiency, economy, and convenience in the operation of the system. 4 refs., 8 tabs.

3307 Emission Control

REFER ALSO TO CITATION(S) 17672, 18472, 18473, 18800, 19106

18534 (PB—88-125208/XAB) Development of an analyzer for exhaust from methanol/hydrocarbon-fueled motor vehicles. Final report. Luu, D.; Gordon, R.J. (Global Geochemistry Corp., Canoga Park, CA (USA)). 20 Jul 1987. 29p. NTIS, PC A03/MF A01.

In order to obtain accurate data for the content of unburned methanol in exhaust gases of vehicles fuelled on methanol mixtures during emissions testing, the California Air Resources Board initiated a study to develop an analyzer that would determine methanol and hydrocarbons separately. Global Geochemistry Corporation has designed and built an instrument for this, based on a modulator which preferentially pulses the concentration levels of methanol in test gas and allows it to be differentiated from hydrocarbons, which are not modulated. It is also responsive to ethanol. The modulator is based on adsorption and desorption of methanol in a packed microtube, controlled by temperature pulses. The unit is a modification of a flame ionization analyzer (FIA) already in use for hydrocarbon analysis.

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 18518

35 ARMS CONTROL

REFER ALSO TO CITATION(S) 20559

18535 (PB—88-855622/XAB) Militarization of space. January 1970-December 1987 (citations from the NTIS data base). Report for January 1970-December 1987. (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 87p. NTIS PC N01/MF N01.

Supersedes PB—87-853065.

This bibliography contains citations concerning existing and projected military utilization of space by the United States and foreign powers. Long-term strategies, technical-feasibility studies, space weapons, including high-energy lasers, shuttle operations, and the use of space in tactical operations are among the topics considered. The Strategic Defense Initiative (SDI) program, and its role in arms control are also discussed. (This updated bibliography contains 177 citations, 57 of which are new entries to the previous edition.)

3503 Verification

REFER ALSO TO CITATION(S) 19101

36 MATERIALS

REFER ALSO TO CITATION(S) 17427

18536 (DOE/ER/45297—7) Superconducting superlattice structures. Makous, J.L.; Leavitt, J.A.; McIntyre, L.C. Jr.; Maritato, L.; Vaglio, R.; Cucolo, A.; Falco, C.M. (Arizona Univ., Tucson (USA); Istituto Nazionale di Fisica Nucleare, Frascati (Italy). Lab. Nazionale di Frascati; Salerno Univ. (Italy). Dipartimento di Fisica). 1987. Contract FG02-87ER45297. 7p. (CONF-871124—64). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005346/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Superlattice superconductors exhibit behavior different from other "homogeneous" superconductors because of their layered structures. Sputtering has proved to be an excellent technique for producing such multilayered systems. Also, systems naturally having layered structures, such as the new high-Tc materials, can be fabricated by sputtering. Here we describe the preparation of superconducting superlattices by dc triode sputtering and techniques useful for characterizing them. In particular, we discuss Mo/Ta superconducting superlattices and high-Tc thin films of YBa_2Cu_3O/ sub 7-x/.

18537 (UCID—20622-87-4) Chemistry and Materials Science quarterly research report: Fourth quarter, FY87. (Lawrence Livermore National Lab., CA (USA)). Dec 1987. Contract W-7405-ENG-48. 136p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88005728/JAW.

This quarterly report describes progress in basic and applied research carried out in the Chemistry and Materials Science Department under the auspices of Weapons Supporting Research (referred to as Chemistry Research Resource, or CRR) and the departmental Institutional Research and Development program. The empasis of the report is on recent progress. The progress report has been divided into broad categories: Advanced Materials, Materials Characterization and Analysis, Physical Metallurgy, Chemical Reactions and Transport Processes, and Properties of Hydrogen Isotopes.

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 17557, 17559, 17596, 17597, 17598, 17806, 17833, 17833, 17876, 17880, 17881, 18044, 18123, 18133, 18133, 18165, 18166, 18168, 18169, 18172, 18172, 18178, 18178, 18226, 18256, 18482, 18705, 18705, 19938, 19948, 19958, 19959, 19959, 19969, 19970, 19971, 19976, 19978, 20453, 20454, 20455, 20455, 20468, 20469, 20470, 20471, 20472, 20473, 20474, 20475, 20476, 20477, 20478, 20479, 20480, 20481, 20482, 20483, 20484, 20485, 20486, 20487, 20488, 20489, 20490, 20491, 20492, 20492, 20493, 20494, 20495, 20496, 20507, 20509, 20512, 20518, 20519, 20525

18538 (ORNL/M—272) Proceedings of the second workshop on nickel aluminides. Weir, J.R. Jr. (comp.). (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 114p. (CONF-8605318—Vugraphs). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88004668/JAW.

From 2. workshop on nickel aluminides; Oak Ridge, TN, USA (13 May 1986).

The basic research program on nickel aluminides has concentrated on four major areas: (1) Improving ductility at ambient temperatures by microalloying with boron and adjusting the composition of the alloy to slightly hypostoichiometric in aluminum (24 at. %), (2) Increasing the high-temperature strength by solid-solution strengthening with small amounts of zirconium or hafnium, (3) Eliminating "dynamic" embrittlement in oxidizing environment at intermediate temperatures (600-800°C) by macroalloying with chromium, and (4) Improving hot fabricability by utilizing modern (isothermal) forging techniques and macroalloying with iron. Limited measurements of the tensile and creep-rupture properties have been made. Weldability investigations were conducted using autogeneous gas-tungsten-arc welding. Tests were performed to characterize heat-affected-zone and fusion-zone cracking. Oxidation resistance and physical properties were also measured.

18539 (EGG-M—11787) Analytically modeling the carbothermic reduction of alumina in a thermal plasma. Varacalle, D.J. Jr.; Schutte, W.C.; VanSiclen, C.D.; Bartlett, R.W. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 26p. (CONF-8711148—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005535/JAW.

From Extractive and process metallurgy fall meeting; Palm Springs, CA, USA (29 Nov 1987).

The in-flight carbothermic reduction of vaporized alumina (Al_2O_3) particles to aluminum was analytically investigated in an argon nontransferred plasma torch. The computational procedure for approximating the plasma physics, particle dynamics, and plasma chemistry of the process is presented. The equations that govern the energy and mass transport in the plasma column and plume are solved numerically to determine the plasma temperature and velocity. The plasma/particle interaction analysis procedure then approximates the trajectories and vaporization of injected par-

ticulates in the plasma jet. The results obtained to date indicate the potential of vaporizing a significant amount of alumina and carbon in a plasma, if the particles are small. The thermochemistry analysis indicates that the carbothermic reduction of alumina is possible for in-flight chemical reactions in a dc nontransferred arc configuration. The economics of the process using a nontransferred configuration is discussed on the assumption that quenching to liquid metal can be achieved. 41 refs., 15 figs., 8 tabs.

18540 (IA—1427, pp 50) **Nitriding mechanisms in Ar+N/sub 2/, Ar+N/sub 2/+H/sub 2/ and Ar+NH/sub 3/ mixtures in low dc glow discharges at low pressure (<10 Torr).** Avni, R.; Spalvins, T. (Israel Atomic Energy Commission, Tel Aviv; National Aeronautics and Space Administration, Cleveland, OH, USA. Lewis Research Center). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18541 (IA—1427, pp 66) **Crystallographic perfection of CdTe crystals as a function of their thermal history.** Feldstein, H.; Raizman, A.; Yellin, N.; Abramovitz, R.; Shaham, H. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18542 (IA—1427, pp 113-115) **Maximum drawing ratio in hydroforming deep-drawing process.** Yossifon, S.; Tirosh, J. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18543 (IA—1427, pp 115-116) **Buckling prevention in cylindrical loose-powder canning in hip or cip processes.** Yossifon, S.; Gefen, Y.; Kalir, D.; Yeheskel, O. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18544 (LA-UR—87-3769) **Texture and sheet forming.** Canova, G.R.; Kocks, U.F.; Fressengeas, C.; Dudzinski, D.; Lequeu, Ph.; Sornberger, G. (Los Alamos National Lab., NM (USA); Compagnie de Produits Chimiques et Electrometallurgiques Pechiney, Centre de Recherches de Voreppe, 38 (France)). 1987. Contract W-7405-ENG-36. 13p. (CONF-8709172—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003158/JAW.

From 8. international conference on textures of materials; Santa Fe, NM, USA (21 Sep 1987).

The classical Marciniak-Kuczynski (Defect) theory, which consists in calculating the behavior of an initial defect in the sheet, in the form of a thin groove, is applied together with a full-constraints or relaxed-constraints theory of polycrystal viscoplasticity. Purpose of this is to investigate the effect of the induced texture on the Forming Limit Diagram (FLD), and the effect of grain shape as well. An alternative fast way of deriving FLD's is also proposed using a perturbation method. Comparisons are made between the results obtained by both Defect and Perturbation theories, in the case of ideal fcc rolling texture components, and in the case of polycrystals. 13 refs., 7 figs.

18545 (LA-UR—87-4088) **Materials dependence of deformation texture development in various deformation modes.** Stout, M.G.; Kallend, J.S.; Kocks, U.F.; Przystupa, M.A.; Rollett, A.D. (Los Alamos National Lab., NM (USA); Illinois Inst. of Tech., Chicago (USA); Przystupa (M.A.), Redondo Beach, CA (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-8709172—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004312/JAW.

From 8. international conference on textures of materials; Santa Fe, NM, USA (21 Sep 1987).

Attempts to understand the development of deformation textures have long been hampered by the following dichotomy: in theory, one expects orientation changes to be governed entirely by the geometry of deformation and thus to be the same for all materials of the same lattice structure and the same deformation modes; yet in experiments, one observes differences between different materials of the same lattice structure. The current work represents an effort to address this problem anew. Four fcc single-phase materials (aluminium, copper, silver, and 70:30 brass) were deformed along three strain-paths (wire-drawing, compression, and torsion), with complete texture determinations before deformation and after strains of roughly 1.0 and 2.0. In parallel, 800 randomly oriented but weighted grains were subjected to simulation of these same tests by the Los Alamos polycrystal plasticity (LApp) code, taking account of the initial textures. An ancillary question which could be addressed in this way is how long initial textures can be remembered by the material; the answer depends on the circumstances and is not always small strains. 8 refs., 3 figs., 1 tab.

18546 (LA-UR—88-6) **The sensitivity of rolling texture predictions to the assumptions used.** Kocks, U.F. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-8709172—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005371/JAW.

From 8. international conference on textures of materials; Santa Fe, NM, USA (21 Sep 1987).

It is demonstrated for the case of rolling textures that simulation results are rather insensitive to some assumptions (as claimed by Leffers), but rather sensitive to others. This degree of sensitivity depends stringly on the total strain simulated. The most crucial influence is exerted by the introduction of relaxed constraints for flat grains.

18547 (ORNL/M—439) **Proceedings of the workshop on recently developed technologies.** Weir, J.R. Jr. (comp.). (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 228p. (CONF-8709223—). NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88003137/JAW.

From Workshop on recently developed technologies; Oak Ridge, TN, USA (21 Sep 1987).

The technology transfer workshop described five technologies recently developed at Oak Ridge National Laboratory (ORNL). Nickel aluminides (Ni_3Al) were the subject of discussion. Weldability of the alloys, machining, tension-fatigue, aqueous corrosion, mass-loss, cyclic oxidation and hot corrosion were reported on. The Sigmajig, a new device to produce quantitative information on the propensity of a metal to crack, was also discussed. Other topics were eddy current testing and equipment, and SiC whisker reinforcement. Ways for national and federal laboratories to work with industry were also presented. Viewgraphs and flow charts are included. (CBS)

18548 (PB—88-127725/XAB) **Reports of the Government Industrial Research Institute, Sikoku, Vol. 18, No. 4, March 1987.** (Government Industrial Research Inst., Shikoku, Takamatsu (Japan)). 1987. 43p. NTIS, PC E03/MF A01.

Text in Japanese with 2 articles in English. See also PB—87-216529.

Contents include: effect of m-a constituent on weld Haz toughness of high-strength low-alloy steel; synthesis of dihydroxamic acid chelating polymers and the adsorptive property for uranium in sea water (in English); recovery of lithium from geothermal water; effect of ozone and oxygen-alkali pretreatment on enzymatic hydrolysis of thermomechanical pulp (in English); adsorption of endo-pectate lyase onto the polysulfone hollow fibers and its prevention method.

18549 (RFP—4129) **Characterization and morphology of pulsed electron beam welding on 21-6-9 stainless steel.** Kautz, D.D. (Colorado School of Mines, Golden (USA)). [1987]. Contract AC04-76DP03533. 123p. (T—3300). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE87010961/JAW.

The purpose of this work was to investigate the usefulness of pulsed electron beam welding in an industrial setting. The author wished to find out whether a pulsed welding source would decrease the power input needed to obtain a given depth of weld penetration, without compromising the quality of the final weldment.

The author also was interested in the use of pulsed electron beam welding of thin to thick sections. For this application, a decrease in the weld toe width was considered to be an improvement in the finished weld. The results of this work indicated that some increase in the weld penetration for a given power input could be obtained with pulsed electron beam welding. However, the fraction of penetration increase in the welds decreased as the power input to the welds was increased. The weld toe width also decreased as the incremental power input to a given length of weldment also decreased. These gains from the use of a pulsed electron beam welding source, were overwhelmed by the poor quality of the finished welds. The welds exhibited a much greater concentration of discontinuities than the continuous wave electron beam welds. The stability of the pulsed electron beam welds was also poor when compared with the continuous wave welds. This author would recommend against using pulsed electron beam welding for typical welding situations. In most cases, weld joint designs can be made to allow for the use of continuous wave electron beam welding. 47 refs., 20 figs., 7 tabs.

18550 **(SAND—87-1334C) Non-selective tungsten CVD using tungsten hexacarbonyl.** Creighton, J.R. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 12p. (CONF-8711124—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003392/JAW.

From Topical conference on deposition and growth: limits for microelectronics; Anaheim, CA, USA (2 Nov 1987).

We have used tungsten hexacarbonyl to deposit thin (<1000 A) non-selective tungsten films on silicon and silicon dioxide at 550°C. Thicker (≃1 micron) tungsten films were then deposited using conventional H_2 reduction of WF_6 at 470°C using the non-selective film as an adhesion layer. Films grown in this manner have excellent adhesion to SiO_2, essentially 100% step coverage, and good resistivity. Samples could be transferred under vacuum from the deposition chamber to a uhv chamber equipped with Aguer spectroscopy, thus allowing surface and interface properties of the tungsten films to be studied at the initial stages of growth. No evidence was found for a stoichiometric tungsten oxide or tungsten silicide at the W/SiO_2 interface. 13 refs., 4 figs.

18551 **Temperature dependence of ion mixing of markers in Zr.** Kim, S.J.; Nicolet, M.A.; Averback, R.S. (California Institute of Technology, Dept. of Electrical Engineering, Pasadena, CA 91125). pp 437-442 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Ion mixing of thin markers in Zr was investigated by irradiating with 660 keV Kr/sup ++/ ions at temperatures between 300 to 423 K. Very thin films of vacuum evaporated Ti, Cr, Fe, Co, Ni, Cu, Hf, W, and Au served as markers. The samples were analyzed by 2 MeV He backscattering spectrometry. The marker elements that are likely to dissolve interstitially in Zr have higher mixing efficiencies at elevated irradiation temperature that the markers that are likely to dissolve substitutionally. The results are explained by radiation-enhanced diffusion theory.

18552 **(AD-A—186367/9/XAB) Investigation of the phase equilibrium of alloys of the ternary system Ti-Al-Nb.** Nartova, T.T.; Sopochkin, G.G. (Air Force Systems Command, Wright-Patterson AFB, OH (USA). Foreign Technology Div.). 9 Sep 1987. 13p. (FTD-ID(RS)T—0744-87). NTIS, PC A03/MF A01.

Edited trans. of mono. Novyy Konstruktsionny Material Titan, Moscow, 19-23(1972), by Carol S. Nack.

This investigation of the constitution diagram of the ternary system titanium-aluminum-niobium is limited to the specific system Ti-Ti3A1-Nb in order to establish the regions of the alpha and beta solid solutions of titanium, the solid solutions based on aluminide Ti3A1, and the phases conjugated with them. The constitution diagram of the systems Ti-A1 and Ti-Nb obtained from the data were used as the basis for constructing the constitution diagram of the ternary system. The methods of microstructural, thermal and X ray phase analysis were used in the study. The X ray pictures were taken in copper emission from powders that had been preliminarily annealed in a vacuum at 600 for 30 min. Iodic titanium, aluminum brand AV-000 and fillet niobium were used as the source materials. The alloys were remelted five times in an electric-arc furnace with a nonconsumable tungsten electrode in an argon atmosphere, and then by crucibleless melting in the suspended state. The constancy of the chemical composition of the alloys was monitored by their weight after smelting in an electric arc furnace.

18553 **(FEI—1718) Frequency spectra of vanadium-oxygen interstitial disordered alloys.** Danilkin, S.A.; Alenicheva, T.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703156/JAW.

Frequency spectra of vanadium-oxygen implantation phase, which were earlier investigated, using neutron inelastic scattering, are calculated within the framework of disordered crystal lattice dynamics model, proposed by Rafizadeh. Calculations are performed for α (3 at.% of oxygen) and β (17 at.%) phases, disordered by oxygen. Spectrum acoustic part deformation and oxygen atom oscillation impurity line broadening take place under oxygen concentration increase in frequency spectra. The impurity bands are of the same width as the experimental one (at 17 at.% concentration), if oxygen atom interaction makes up — 5 C (C is the interaction constant of the closest vanadium atoms). However, at such an oxygen atom interaction constant the impurity band width at oxygen concentration of 3 at.% is much less than its experimental values which is an indication of the existence of an additional broadening mechanism in the vanadium-oxygen α-phase case. 8 references, 8 figures.

18554 (IA—1427, pp 97) **Structural and electronic effects of the solid state-amorphization and recrystallization of Cu-Ho thin films.** Venkert, M.; Shamir, N.; Atzmony, U.; Dariel, M.P.; Talianker, M. (Israel Atomic Energy Commission, Tel Aviv; Ben-Gurion Univ. of the Negev, Beersheba, Israel). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18555 **(IAE—4419/11) X-ray study of texture in zirconium alloy tubes and in graphite.** Skvortsov, V.V.; Alekseev, S.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1987. 27p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701432/JAW.

X-ray study of texture in zirconium alloy tubes and in graphite has been developed. The method is based on constructing coordinate grid of stereographic projection determining quantity and coordinates of points where measurements should be performed depending on a specimen slope pitch. Complete stereographic projection obtained so is a base both for constructing pole figures showing distribution normales of plane system being studied and for calculating texture coefficients determining property anisotropy in materials under investigation. This method can be applied to study texture in items of any materials independent of the item shape. 20 refs.; 14 figs.

18556 **(LA-UR—88-5) A symmetric set of Euler angles and oblique orientation space sections.** Kocks, U.F. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-8709172—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005317/JAW.

From 8. international conference on textures of materials; Santa Fe, NM, USA (21 Sep 1987).

A slight variation of conventional definitions is proposed which treats the relation between crystal and sample systems as symmetrical and simplifies the procedure of plotting or identifying individual orientations. The specific convention proposed uses the Roe angles psi and θ, but replaces Roe's PHI by phi identical to π - PHI. For plotting the oblique sections proposed at this conference to avoid the remaining distortions near $\theta = 0$, one may define nu identical (psi + phi)/2; the aximuthal angle in the sections may then be either = identical (psi - phi)/2 for maximum symmetry, or psi for obtaining partial pole figures, or phi for partial inverse pole

figures. Any of the sections follow from any other by a simple turning of the figure, by an amount that depends on the section parameter.

18557 **(LBL—23927) Recent progress in structure determination by LEED [low-energy electron diffraction].** Van Hove, M.A.; Somorjai, G.A. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 13p. (CONF-8709212—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003851/JAW.

From 4. international symposium on surface physics; Bechyne, Czechoslovakia (7 Sep 1987).

Surface crystallography with low-energy electron diffraction (LEED) is shown to be developing fast towards solving more complex and diverse kinds of surfaces. This progress is exemplified here with solved structures in three very diverse categories: (1) metal surface reconstructions with multi-layer relaxations: (2) coadsorption of different molecules on metal surfaces; and (3) incommensurate overlayers of graphite on Pt(111). 21 refs., 4 figs.

18558 **(LBL—24262) Electronic structure and phase stability of alloys.** de Fontaine, D. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 15p. (CONF-8705226—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004574/JAW.

From U.S.-Japan seminar on electronic structure and lattice defects in alloys; Honolulu, HI, USA (4 May 1987).

The computation of phase diagrams from first principles requires the combination of very precise quantum mechanical, statistical mechanical, and ground state calculations. Various methods of accomplishing this task are reviewed, such as the Gautier and Ducastelle Generalized Perturbation Method and the cluster inversion method of Connolly and Williams. As an example of the former, a calculation of the Ti-Rh phase diagram is presented. 38 refs., 3 figs.

18559 **(RFP—4123) Grain refinement during primary breakdown of alloy 718.** Mataya, M.C.; Robinson, M.L.; Chang, D.; Weis, M.J.; Edwards, G.R.; Matlock, D.K. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant; Carpenter Technology Corp., Reading, PA (USA); Colorado School of Mines, Golden (USA). Advanced Steel Processing and Products Research Center). 1987. Contract AC04-76DP03533. 28p. (CONF-8710264—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005193/JAW.

From Iron and Steel Society of ATME; Toronto, Canada (23 Oct 1987).

Grain refinement during primary breakdown of a production size alloy 718 ingot was investigated by compression testing of cylindrical specimens taken from various locations in the ingot cross section. Deformation was applied over a temperature range of 900 to 1150°C, at strain rates from $0.1s^{-1}$ to $1.0s^{-1}$, and to strains of 0.25 to 1.0. Variations in grain morphology and orientation had a pronounced effect on the deformed sample geometry but little effect on recrystallization. Recrystallization was observed to nucleate at primary particles and high angle grain boundaries. Static recrystallization rather than dynamic recrystallization was the mechanism responsible for refinement of the coarse cast structure. The cycle time for one pass was identified as the criticl processing variable with respect to microstructural evolution for a set of deformation conditions typically used during breakdown by radial forging. 10 refs., 18 figs.

18560 **(SAND—87-1553C) Phase selection in undercooled liquids of pulsed-laser melted alloys.** Follstaedt, D.M.; Peercy, P.S.; Perepezko, J.H. (Sandia National Labs., Albuquerque, NM (USA); Wisconsin Univ., Madison (USA). Dept. of Metallurgical and Mineral Engineering). 1987. Contract AC04-76DP00789. 15p. (CONF-871124—33). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004021/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The use of thermodynamic analysis of phase relationships to identify metastable conditions for generating undercooled liquids by pulsed laser melting, and to interpret the resulting microstructures is illustrated from studies of Mn, FeV and TiAl. Phases with simple, disordered structures are found to nucleate and grow within tens of nanosecods in liquids undercooled by 50 to 100 K. An extended transformation depth is found in which the stable high-temperature α phase replaces the metastable σ phase in FeV due to the heat release from the rapidly forming α phase. The formation of the disordered bcc structure and of a metallic glass in the melt of the ordered compound γ-TiAl indicate that regrowth of this phase is sufficiently slow to generate undercoolings of $\sim$1000 K. 41 refs., 9 figs., 2 tabs.

18561 **(SAND—87-1577C) Rapid e-beam heating for measuring thermodynamics of metastable materials.** Knapp, J.A.; Follstaedt, D.M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 12p. (CONF-871124—47). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003565/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

A line-source electron-beam system has been used to heat thin surface layers of metastable phases at a rate which precludes solid-state transformation to stable phases, thus permitting the observation of melting transitions normally missed with slow heating. A detailed examples of a new approach to this method is shown for metastable icosahedral Al-Re and crystalline Al_6Re. 8 refs., 4 figs.

18562 **(SAND—87-1935C) Evaluation of CVD [chemical vapor deposition] tungsten films for diffusion barrier applications.** Gutierrez, G.M.; Blewer, R.S.; Tracy, M.E. (New Mexico Univ., Albuquerque (USA); Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-8710225—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004346/JAW.

From Workshop on tungsten and other refractory metals for VLSI applications; Yorktown Heights, NY, USA (7 Oct 1987).

Aluminum-tungsten-silicon ohmic structures have been formed using Al sputtering and W chemical vapor deposition (CVD) techniques. This study evaluates the effectiveness of the CVD tungsten layer as a diffusion barrier between aluminum and silicon in planar geometries. The Al/W/Si ohmic structures underwent 30 minute anneals at selected temperatures up to 550°C and in one of three different anneal gas environments. The results show that 200 nm of CVD tungsten is an effective diffusion barrier in planar geometries at processing temperatures of 500°C of less, following 30 minute anneals in hydrogen, nitrogen, or forming gas ambients. 2 refs., 4 figs.

18563 **(SAND—87-2796C) Energetics of adsorbed dimers via self-consistent scattering theory.** Feibelman, P.J. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 13p. (CONF-871124—39). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003791/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

A new approach to the surface electronic structure problem, based on a self-consistent scattering theory of point defects, permits 1st-principles calculations for an isolated cluster of adatoms and defects on an otherwise perfect infinite crystalline surface. A first numerical application of the method explains important observations concerning the interaction and diffusion of aluminium adatom dimers on Field Ion Microscope tips. 9 refs.

18564 **(SAND—88-1525C) Thermal stability of amorphous Ni-Nb thin films for use as diffusion barriers.** Farrens, S.N.; Perepezko, J.H.; Doyle, B.L.; Lee, S.R. (Sandia National Labs., Albuquerque, NM (USA); Wisconsin Univ., Madison (USA)). 1987. Contract AC04-76DP00789;FG02-84ER45069. 5p. (CONF-871124—29). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003936/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The usefulness of amorphous metal thin films as diffusion barriers or as primary metallizations is limited by the thermal stability of the amorphous material to crystallization. The interdiffusion and crystallization reactions between amorphous Ni-Nb alloy films and Si substrates and several overlayer metals have been monitored

by x-ray diffraction and high resolution Rutherford backscattering spectroscopy. Free standing amorphous thin films of Ni-Nb alloys crystallize in one hour at temperatures between 600-625°C and show little dependence of the crystallization temperature, T/sub x/, on composition over the range from 30-80 at. % Ni. However, in films that are sputter deposited onto Si substrates T/sub x/ tends to increase with increasing Nb composition. $Ni_{90}Nb_{10}$ samples without overlayers crystallize at 650-700°C. Enhancement of the thermal stability to 700-750°C is achieved with a Nb overlayer. In contrast, a Ni overlayer can reduce T/sub x/ to 450°C. At the film/substrate interface silicide formation reactions with Ni from the film contribute to a destabilization of the amorphous alloy. The modification of T/sub x/ with Ni, Nb, and other overlayers appears to be related to changes in the reaction kinetics associated with penetration of the overlayer into the film. 7 refs., 2 figs., 1 tab.

18565 **(UCRL—97761) Exploring the relation between interface structure and mechanical properties in multilayer structures.** Jankowski, A.F.; Makowiecki, D.M.; McKernan, M.A.; Nutt, S.R. (Lawrence Livermore National Lab., CA (USA); Brown Univ., Providence, RI (USA). Div. of Engineering). Nov 1987. Contract W-7405-ENG-48. 8p. (CONF-871124—63). NTIS, PC A02. Order Number DE88005428/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The relationship between microstructure and physical behavior is especially pronounced in synthetic multilayer materials. Insight to the mechanisms responsible for changes in the mechanical properties can be investigated through a careful examination of the inherent microstructure. A dominant feature of the multilayer structure is the interface. The population of interlayer boundaries, that is interfaces, is directly controlled by the multilayer period for any given film thickness. In this paper, we will present TEM images of multilayer systems. The interface structure will be viewed in cross-section. A range of layer thicknesses should be considered as variations in the elastic modules, yield stress, and microhardness have been observed for many noble-transition metal systems over a wide range of multilayer periods, from less than 1 nm to greater than 1000 nm. In epitaxial systems, the extent of superlattice perfection (coherency effects) is closely tied with changes in physical behavior. In summation, emphasis will be placed on the structure and strain distribution from the interface, and its role in determining the mechanical properties of multilayers. 23 refs., 2 figs.

18566 **SIMS study of hydrogen at the surface and grain boundaries of nickel bicrystals.** Ladna, B.; Birnbaum, H.K. (Dept. of Materials Science, Univ. of Illinois at Urbana-Champaign, 1304 W. Green Street, Urbana, IL 61801). *Acta Metallurgica;* **35**: No. 10, 2537-2542(Oct 1987).

The distribution of deuterium at the surface and at grain boundaries of cathodically charged nickel bicrystals was studied using Secondary Ion Mass Spectrometry. Both high energy and low energy boundaries were studied under conditions where deuteride formation occurred during charging. The formation of the deuteride along the grain boundaries was compared to that in the adjacent grains and interpreted in terms of the deuterium diffusion in the lattice and along the grain boundaries. Decomposition of the deuteride was also studied. The results are interpreted in terms of the dependence of diffusion along grain boundaries on the structure of the boundary.

18567 **Planar to cellular transition during the directional solidification of alloys.** Eshelman, M.A.; Trivedi, R. (Ames Lab., USDOE and the Dept. of Materials Science and Engineering, Iowa State Univ., Ames, IA 50011). *Acta Metallurgica;* **35**: No. 10, 2443-2452(Oct 1987). Contract W-7405-ENG-82.

The planar to cellular interface transition during the directional solidification of a binary alloy has been studied in the succinonitrile-acetone system. The interface velocity at which the planar interface becomes unstable and the wave numbers of the initially unstable interface have been precisely determined and compared with the linear stability analysis. Critical experiments have been carried out to show that the planar to cellular bifurcation is subcritical so that a finite amplitude perturbation below the critical velocity can also give rise to planar interface instability.

18568 **Phase selection during pulsed laser annealing of Fe-V alloys.** Perepezko, J.H.; Follstaedt, D.M.; Peercy, P.S. (Univ. of Wisconsin, 1509 University Avenue, Madison, WI 53706). pp 161-166 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Pulsed laser melting of the low-temperature σ (tetragonal, D8/sub b/) phase has been used to generate a liquid undercooled with respect to the melting point of the higher-temperature, equilibrium α (bcc) solid solution in equiatomic Fe-V alloys. From calculations based on reported thermodynamic data and equilibrium transformation temperatures, the metastable melting point of the σ phase is about 1720 K for an Fe-50 at.% V alloy, which is 54 K below the melting temperature of the α phase. During rapid heating of well-annealed σ-phase material with a 30 ns laser pulse to above melt threshold, the $\sigma \rightarrow \alpha$ reaction is suppressed, so that the melt zone is undercooled by — 54 K with respect to the equilibrium α phase. The α phase nucleates from the undercooled molten surface layer and is retained during the subsequent rapid cooling (— 10/sup 10/ K/s) because of the relatively sluggish $\alpha \rightarrow \sigma$ transformation. X-ray diffraction (Read camera) and TEM identified the σ phase in the near-surface after melting σ with incident laser energies (1.0-1.41 J/cm/sup 2/) which are well above the melt threshold as determined by changes in reflectivity (— 0.7 J/cm/sup 2/). The α phase nucleated from the undercooled liquid within — 20 ns.

18569 **Melting point measurements for quasicrystalline phases.** Knapp, J.A.; Follstaedt, D.M. (Sandia National Labs., Albuquerque, NM 87185). pp 167-172 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—). Contract AC04-76DP00789.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Melting transitions of metastable quasicrystalline phases of Al-Mn have been observed using rapid electron-beam heating of fine-grained icosahedral surface layers. The congruent melting point for icosahedral Al/sub 80/Mn/sub 20/ was directly measured to be 910 +- 20°C. Heating to higher temperatures shows another transition which is inferred to correspond to the liquids of the decagonal phase at 965 +- 20°C for 20 at .% Mn. The microstructure and formation kinetics of the decagonal phase are discussed, and its electron diffraction is described.

18570 **The effect of cooling rate during rapid solidification on the structure and texture of NiTi.** Pedraza, A.J.; Godbole, M.J.; Kenik, E.A.; Pedraza, D.F.; Lowndes, D.H. (Dept. of Materials Science and Engineering, The Univ. of Tennessee, Knoxville, TN 37996-2000). pp 185-190 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

A study has been conducted on the effects of increasing cooling rate during rapid solidification of NiTi upon the phases that are produced. The hammer and anvil rapid solidification technique and laser melting with a nanosecond excimer laser were used, which allow the cooling rate to be varied by three to four orders of magnitude. Although 1/3 {110} superlattice reflections are seen in the selected area diffraction (SAD) patterns of the splat quenched (SQ) specimens, x-ray diffraction analyses show the presence of only B2 phase and martensite. On the other hand, laser treatment (LT) of the specimens produces a layer that has a L1/sub 0/ structure with a slight monoclinic distortion. This phase can be envisaged as a small distortion of a B2 unit cell with a volume per atom —3.3% lower than the equilibrium B2 phase. Also martensite is present in the layer. SQ alloys exhibit a marked {200} texture due to columnar growth opposite to the direction of heat extraction, while LT produces epitaxial regrowth of the melted layer. No substantial disordering is obtained in NiTi rapidly solidified alloys.

18571 Precipitation of Kr in Ni at room temperature. Birtcher, R.C.; Liu, A.S. (Materials Science Div., Argonne National Lab., Argonne, IL 60439). pp 345-350 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—). Contract W-31-109-ENG-38.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The fluence dependence of Kr precipitation in Ni at room temperature has been studied with the aid of Transmission Electron Microscopy. As in other metals, the Kr precipitates in small cavities. Electron diffraction demonstrates that the Kr precipitates are solid, fcc crystals aligned with each other and the Ni lattice. The trends are similar to those observed for Kr precipitation in Al at room temperature. The average Kr lattice parameter, determined from the electron diffraction, increases with increasing Kr fluence from 0.515 nm to an asymptotic value of 0.545 nm. The asymptotic limit is due to the melting of the larger Kr precipitates. The mismatch between the Kr and Ni lattices is as large as 55%. Diffuse electron scattering was observed from large, liquid Kr precipitates. This occurs for Kr fluences above 5 . 10/sup 20/Kr/sup +/m/sup -2/ in Ni and above 2.5 . 10/sup 20/Kr/sup +/m/sup -2/ in Al. At room temperature, the largest solid Kr precipitate observed in dark field images was 8.3 nm in diameter compared to 4.7 nm in Al. The larger precipitates are liquid or gas. The solid Kr metals at the same lattice parameter in both Ni and Al suggesting that the melting is thermodynamic in nature and independent of the host material.

18572 Precipitation of krypton in an amorphous Ti-Cr alloy. Allen, C.W.; Birtcher, R.C. (Materials Science Div., Argonne National Lab., Argonne, IL 60439). pp 351-356 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—). Contract W-31-109-ENG-38.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Results of a TEM investigation of the microstructural changes produced by the room temperature implantation of energetic Kr/sup +/ ions into a glassy Ti-Cr thin film are reported. As in other metals, the Kr precipitates as solid crystallites. The precipitation of crystalline Kr is accompanied by ultrafine crystallization of the metal host around each Kr crystal. With increasing fluence, the Kr precipitates grow to a critical size at which they melt, and the adjacent fine metal crystals disappear. A new TEM imaging technique is described briefly which utilizes the small angle electron scattering fine structure and which in principle is capable of revealing all fine particles simultaneously.

18573 The effect of damage density profile on moving species in ion-induced reactions. Tao, K.; Hewett, C.A.; Lau, S.S.; Buchal, C.; Poker, D.B. (Dept. of Electrical Engineering and Computer Sciences, Univ. of California, San Diego, La Jolla, CA 92093). pp 431-436 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The authors present evidence in this study that the moving species under ion mixing conditions are affected by the implantation damage distribution in the sample. This observation holds for metal-metal and semiconductor-semiconductor systems. The direction of thermal annealing and atomic transport appears to play a role in ion-mixing as well. When these two factors are in the same direction, only one dominant moving species is observed. When these two factors are in opposite directions, both constituents can contribute to the atomic transport in ion mixing.

18574 Microstructure of rapidly solidified magnesium-silicon alloys. Grensing, F.C.; Fraser, H.L. (Dept. of Materials Science and Engineering, Univ. of Illinois, 1304 W. Green Street, Urbana, IL 61801). *Scripta Metallurgica;* **21**: No. 7, 963-966(1987).

The appearance of three different microstructures in these alloys may be explained in a manner similar to that used in the case of zone A microstructures in Al alloys. Because of the many similarities between dilute Mg-Si and some Al-transition metal alloys, it is of interest to apply rapid solidification processing to hypereutectic Mg-Si alloys in an attempt to produce similar microstructural modifications leading to an anticipated improvement in mechanical properties. The results of such experiments are described.

18575 Modeling chromium depletion in Ni-Cr-Fe alloys. Was, G.S. (Dept. of Nuclear Engineering, The Univ. of Michigan, Ann Arbor, MI 48109). pp 151-170 of Computer simulation of microstructural evolution. Srolovitz, D.J. Warrendale, PA; The Metallurgical Society Inc. (1986). (CONF-8510160—).

From ASM metals congress/TMS-AIME fall meeting; Toronto, Canada (13 Oct 1985).

Thermodynamic and kinetic models are constructed to describe the development of the chromium depleted zone in Ni-Cr-Fe alloys heated in the range 773K to 1173K. The thermodynamic model is constructed using the Kohler method for the description of the free energy of a multi-component system. It provides the chromium concentration at the carbide-matrix interface as a function of alloy composition and temperature. The kinetic model tracks the shape of the chromium profile as a function of time at temperature and grain size. These models are formulated into two computer codes, DEPLETE which is applicable to single step isothermal heat treatments and DEPLETE II, which applies to multistep thermal treatments as well as heating and cooling. Model results show that the interfacial chromium concentration decreases for increasing carbon concentration and decreasing heat treatment temperature. Grain shape only becomes important for grain sizes less than nm. Experimental verification of the model is made using high resolution energy dispersive x-ray analysis via STEM. Measured results agree well with model results for the dependence of chromium depletion on various input parameters as well as the magnitude and shape of the chromium depleted zone. Results also show that the maximum temperature attained during the thermal treatment process controls the width of the chromium concentration profile whereas the final temperature controls the grain boundary chromium concentration.

18576 Computer simulation of microstructural dynamics. Grest, G.S.; Anderson, M.P.; Srolovitz, D.J. (Corporate Research Science Lab., Exxon Research and Engineering Co., Annandale, NJ 08801). pp 21-32 of Computer simulation of microstructural evolution. Srolovitz, D.J. Warrendale, PA; The Metallurgical Society Inc. (1986). (CONF-8510160—).

From ASM metals congress/TMS-AIME fall meeting; Toronto, Canada (13 Oct 1985).

Since many of the physical properties of materials are determined by their microstructure, it is important to be able to predict and control microstructural development. A number of approaches have been taken to study this problem, but they assume that the grains can be described as spherical or hexagonal and that growth occurs in an average environment. We have developed a new technique to bridge the gap between the atomistic interactions and the macroscopic scale by discretizing the continuum system such that the microstructure retains its topological connectedness, yet is amenable to computer simulations. Using this technique, the authors studied grain growth in polycrystalline aggregates. The temporal evolution and grain morphology of the authors' model are in excellent agreement with experimental results for metals and ceramics.

18577 Computer simulation of dislocation production and recovery for irradiated metals. Henager, C.H. Jr.; Simonen, E.P. (Pacific Northwest Lab., Richland, WA 99352). pp 137-150 of Computer simulation of microstructural evolution. Srolovitz, D.J. Warrendale, PA; The Metallurgical Society Inc. (1986). (CONF-8510160—). Contract AC06-76RL01830.

From ASM metals congress/TMS-AIME fall meeting; Toronto, Canada (13 Oct 1985).

The effect of the thermal stability of interstitial dislocation loops on the hardening-softening transition temperature of irradiated metals was explored with a simple computer model. Destabiliz-

ing the interstitial loop population by simulating spontaneous thermally-activated unfaulting reduced the hardening-softening transition temperature significantly. Simulated loop unfaulting shifted the transition temperature shown down 50 K for both annealed and cold-worked microstructures. Interstitial loop growth, loop coalescence with network dislocations, and network recovery were simulated using rate equations. Simple expressions for dipole recovery, dislocation intersections, and loop behavior were developed. The model correctly predicts typical trends observed in irradiated metals. These trends include saturation of the dislocation density at high irradiation doses and a decrease in loop density with increasing irradiation temperature. However, the model underestimates the total loop densities and, therefore, the magnitude of the predicted strengths and softening temperatures are less than observed.

18578 **(BARC—1346) Development of a computer code 'CRACK' for elastic and elastoplastic fracture mechanics analysis of 2-D structures by finite element technique.** Dutta, B.K.; Kakodkar, A.; Maiti, S.K. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701231/JAW.

The fracture mechanics analysis of nuclear components is required to ensure prevention of sudden failure due to dynamic loadings. The linear elastic analysis near to a crack tip shows presence of stress singularity at the crack tip. The simulation of this singularity in numerical methods enhance covergence capability. In finite element technique this can be achieved by placing mid nodes of 8 noded or 6 noded isoparametric elements, at one fourth ditance from crack tip. Present report details this characteristic of finite element, implementation of this element in a code 'CRACK', implementation of J-integral to compute stress intensity factor and solution of number of cases for elastic and elastoplastic fracture mechanics analysis. 6 refs., 6 figures.

18579 **(CEA-CONF—9098) Modes of failures: primary and secondary stresses.** Roche, R.L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Jul 1987. 22p. (CONF-870636—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751858/JAW.

From 5. national congress on pressure vessels and piping; San Diego, CA, USA (28 Jun 1987).

The paper begins with a reminder that the purpose of stress classification is to ensure suitable margins with respect to failure modes. The distinction between primary stresses and secondary stresses is then examined and a method is given for assessing the degree of elastic follow up in the elastic plastic field. The importance of elastic follow up is then highlighted by an examination of the effect of primary and secondary stresses on crack behavior.

18580 **(CEA-N—2523) Fatigue analysis - computation of the actual strain range using elastic calculation.** Roche, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). Apr 1987. 45p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753180/JAW.

The design codes used in nuclear industry do not contain all the same rules allowing to deduce from an elastic calculation the actual deformation variation. Knowledge of strain range is needed for fatigue analysis. Elastic calculation does not give the actual range. The aim of this paper is discussing ways to correct elastic results and proposing a practical method to do it. Two corrections are required. The first one is related to elastic follow up effect when shakedown is not obtained (correction on secondary stress). The second one is related to stress raisers effect (correction on peak stress). It is shown that NEUBER's rule is not convenient for the second correction when shakedown is not fulfilled.

18581 **(DOE/ER/12092—T1) Non-destructive evaluation techniques applied to the study of fatigue microcrack growth in steel alloys: Final report.** London, B.; Yuce, H.; Nelson, D. (Stanford Univ., CA (USA)). Oct 1987. Contract AS03-82ER12092. 397p. NTIS, PC A17/MF A01; 1; GPO Dep. Order Number DE88004090/JAW.

In Part I of this study, an ultrasonic surface acoustic wave (SAW) technique was used to monitor the depth of surface fatigue microcracks in 300M steel as they grew. This technique also provided information on the stress which must be applied to cause the cracks to fully open. Values of crack opening stress obtained by scanning electron microscope (SEM) measurements of crack tip opening displacements were compared with values determined acoustically. Good agreement was obtained. 300M steel, heat treated to yield strength of 1737 MPa, was tested at two different zero-to-maximum tension stress levels. Effects of residual stresses produced by two different surface preparations on the growth of small cracks were studied. One preparation was electropolishings while the other was stress-relieving followed by diamond paste polishing. Fatigue microcrack growth rate agreed well with that of large cracks in electropolished specimens but, the presence of shallow compressive residual stresses in other specimens caused growth rates as much as an order of magnitude lower than in electropolished specimens. In Part II, four different microstructures of 4140 steel were investigated. Small fatigue crack behavior was monitored using a surface acoustic wave ultrasonic technique to accurately measure crack depth and crack closure stress. Cracks from 50 to 200 μm in depth in specially designed catilevered bending samples were investigated. 143 refs., 74 figs., 5 tabs.

18582 **(DOE/ER/45255—2) Stress corrosion cracking and metal-induced embrittlement: Comparative studies of local chemistries: Progress report, January 16, 1987-January 15, 1988.** Heldt, L.A.; White, C.L. (Michigan Technological Univ., Houghton (USA). Dept. of Metallurgical Engineering). Jan 1988. Contract FG02-86ER45255. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003235/JAW.

Brass crystals 6 mm diameter and 12 cm long were grown and cylindrical tensile specimens were prepared having reduced gauge sections. These samples were tested in distilled water at constant strain rate and at various electrochemical potentials. In addition, since fracture resulted in extremely large facets, the crystallography of fracture was determined. Crystals 3.8 cm diameter by 23 cm long were also prepared. Crack propagation studies were performed and propagation rates were determined. Plastic deformation and strain history effects were also investigated. 5 refs., 11 figs. (CS)

18583 **(EGG-M—05687) Creep behavior of consolidated rapidly solidified Type 304 stainless steel powder containing helium.** Flinn, J.E.; Korth, G.E.; Wright, R.N. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 23p. (CONF-8710110—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005536/JAW.

From Fall meeting of The Metallurgical Society of the American Institute of Mining and Metallurgical Engineers; Cincinnati, OH, USA (10 Oct 1987).

An investigation on the creep behavior of extrusion consolidated Type 304 SS powder containing approximately 7 appM helium was performed. The helium was entrapped during powder processing by centrifugal atomization (CA) and retained through consolidation. In comparison with a wrought ingot metallurgy (I/M) reference of Type 304 SS, the CA SS extruded powder material showed considerable creep resistance with nearly a factor of 30 extension in rupture time and a two order in magnitude decrease in minimum creep rate observed. No obvious embrittlement influences from the helium were observed. Preconditioning heat treatments on the CA 304 SS extruded powders influenced the creep properties. A 900°C-1 h heat treatment resulted in higher ductilities, shorter rupture times, and higher minimum creep rates compared to specimens heat treated for 1 h at 1200°C. The fracture patterns were also significantly different where highly elongated grains and grain boundary cavitation were observed for the 900°C heat treated specimens whereas the 1200°C heat treated specimens display wedge cracking and very little grain elongation. 19 refs., 8 figs., 2 tabs.

18584 **(FHG-W—5/87) J-integral concept for elastic-plastic material behavior.** Schmitt, W.; Kienzler, R. (Fraunhofer-Institut fuer Werkstoffmechanik, Freiburg im Breisgau (Germany, F.R.)). Mar 1987. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751959/JAW.

A simple analytical extension of the J integral has been presented which extends the J concept to apply for materials described by an incremental theory of plasticity. The stress work density replacing the strain energy density is load-history dependent. The J integral may be made path independent by virtue of an additional volume integral and may be understood as work dissipation rate. The discussion of the consequences for the applicability of the J concept to describe fracture processes showed that validity criteria proposed in the standards are not sufficient to yield configuration-independent J-resistance curves. However, a possibility is sketched to assess those structure-dependent resistance curves based on plastic-collapse considerations. With 6 figs., 33 refs.

18585 (IA—1427, pp 87-88) **Trapping of hydrogen around helium bubbles.** Abramov, E.; Eliezer, D. (Israel Atomic Energy Commission, Tel Aviv; Ben-Gurion Univ. of the Negev, Beersheba, Israel). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18586 (IA—1427, pp 93-94) **Static and dynamic bifurcation in magnetoelastic ribbons.** Savage, H.T.; Adler, C.L.; Antman, S.S.; Melamud, M. (Naval Surface Weapons Center, Silver Spring, MD, USA; Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18587 (IA—1427, pp 223-224) **Application of ion implantation for modifying tribological properties.** Lempert, G.; Chavet, I.; Kanter, M.; Melnick, M. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18588 (LA-UR—88-7) **The path dependence of deformation texture development.** Takeshita, T.; Kocks, U.F.; Wenk, H.R. (Los Alamos National Lab., NM (USA); California Univ., Berkeley (USA). Dept. of Geology and Geophysics). 1987. Contract W-7405-ENG-36. 5p. (CONF-8709172—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005372/JAW.

From 8. international conference on textures of materials; Santa Fe, NM, USA (21 Sep 1987).

It is demonstrated for the case of three different strain paths, all of which end up with the same, elongated specimen shape, that the texture developed during straining is path dependent. This is true both for experiments on aluminum polycrystals and for simulations using the LApp code.

18589 (LBL—24575) **Cryogenic mechanical properties of 18Mn-16Cr-5Ni-0.2N weldments.** Chan, J.W. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005741/JAW.

Advanced high field superconducting magnets intended for use in the next generation of magnetic confinement fusion devices will require structural alloys with high yield strength and high toughness at cryogenic temperatures. The proposed Japanese Fusion Engineering Reactor calls for use of magnet casing alloys with 4°K yield strength of 1200 MPa and fracture toughness of 200 MPa-m/sup 1/2/ in the base plate with matching properties in the weldments. The proposed US requirements are 1200 MPa and 200 MPa-m/sup 1/2/ in the base plate and 1000 MPa with 150 MPa-m/sup 1/2/ in the weldments. Commercially available alloys used in the current generation of magnets, such as 300 series stainless, do not have the required properties. Recently developed N-strengthened, high-Mn alloys meet base plate requirements in the as-hot-rolled condition. However, it is not clear how much the weldment properties deteriorate or how these propery changes are related to weldment microstructural and chemical changes. Welding induced cryogenic mechanical property changes of an 18Mn-16Cr-5Ni-0.2N alloy are here measured and correlated with as-solidified weld microstructures and chemistries. Autogenous GTA weldments on the as-hot-rolled base plate show a decrease in 4°K yield strength and fracture toughness. Most of the strength decrease can be attributed to the depletion of interstitial nitrogen from the fusion zone during welding. Weldment yield strength decrease can be compensated by N addition to the weld through the shield gas. 4°K fracture toughness loss is due to retention of δ-ferrite for welds which solidify as primary ferrite. Fracture toughness can be increased by process or chemistry modifications which reduce retained ferrite content and break up continuity of the retained ferrite. Low fracture toughness in welds which solidifies as primary austenite is associated with inhomogeneous deformation behavior. 19 figs., 7 tabs., 50 refs.

18590 (NP—8751946) **Fracture behaviour on weld joints of high-strength steels.** Eichhorn, F.; Groeger, P.; Nies, H.; Pyrasch, D.; Remmel, J. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl und Inst. fuer Schweisstechnische Fertigungsverfahren; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jun 1986. 182p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88751946/JAW.

High-strength fine grained structural steels are used increasingly in vessel construction and off-shore technique because of their high strength and good toughness at low temperatures and their good weldability. 40 mm thick plates of different strength levels and heat treatments were joint welded by conventional mechanised high performance procedures like submerged-arc welding or electroslag welding as well as by processes increased in performance like multi-wire submerged arc welding, electroslag and electrogas-high speed welding and GMA-narrow gap welding in tandem position. The suitability for welding fine grained structural steels using these processes was proved by metallographic investigations in effects of different heat influences caused by use of different welding processes. Final review will be possible after investigations in mechanical properties, which will be carried through at the IEhK within a cooperative research program. With 17 refs., 35 tabs., 93 figs.

18591 (UCID—21296) **Metallurgical analysis of fractured F-27 aircraft landing gear.** Witherell, C.E. (Lawrence Livermore National Lab., CA (USA)). 15 Dec 1987. Contract W-7405-ENG-48. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005885/JAW.

The Materials Division of LLNL's Chemistry and Materials Science Department was asked to conduct a study of a fractured component of the main (starboard) landing gear on the F-27 aircraft (N768RL). The purpose of the study was to determine from metallurgical evidence the probable failure mode, its cause, and contribution to the recent landing incident at Livermore. 21 refs., 15 figs., 1 tab.

18592 **Controlling factors for crack growth under creep conditions.** Wang, J.S.; Kim, Y.S.; Nix, W.D. (Div. of Applied Sciences, Harvard Univ., Cambridge, MA 02138). *Acta Metallurgica;* **35**: No. 10, 2593(Oct 1987).

The creep crack growth behavior of a class I solid solution alloy, Cu-2.7 at.% Sn, has been investigated. The characteristics of creep crack growth of this class I solid solution alloy are found to be the same as those of pure metals and class II solid solution alloys. Crack growth involves a transient stage and a constant growth rate stage. The crack growth behavior in the transient stage can be characterized by the line integral C/sub 1/, while at steady state neither the path independent line integral C/sub 1/ nor the stress intensity factor applies. However, steady state crack growth can be characterized by the power release rate C/sub rho/ measured using a technique developed by Landes and Begley. The results suggest that the HRR stress field does not exist when extensive damage occurs and that steady state creep crack growth is not due to a stress singularity. Rather, crack growth appears to occur in a progressive manner because of a damage gradient which develops during the transient stage.

18593 **Characterization of the strength and microstructure of heavily cold worked Cu-Nb composites.** Spitzig, W.A.; Pelton, A.R.; Laabs, F.C. (Metallurgy and Ceramics Div., Ames Lab.-USDOE, Iowa State Univ., Ames, IA 50011). *Acta Metallurgica;* **35**: No. 10, 2427-2442(Oct 1987). Contract W-7405-ENG-82.

The mechanical properties and microstructures have been evaluated for heavily cold worked wires of Cu-12% Nb and Cu-20% Nb composites. The strength of these composites increases dramatically with increasing deformation up to a true strain of 11.9, the maximum investigated. This continued strengthening is a consequence of deformation-induced microstructural changes in both Cu and Nb. During deformation the Nb precipitates adopt a filamentary morphology, and both the size and spacings of these filaments decrease. The microstructural evolution in the Cu matrix involves a deformation-recovery-recrystallization cycle, which allows further deformation and the concurrent refinement of the Nb. Strengthening in these composites appears to arise from the Nb filaments which act as planar barriers to plastic flow between the two phases. The strength of these composites is dependent on the spacing of the Nb filaments in accord with a Hall-Petch relationship. Furthermore, it was found that due to the deformation, induced recovery and recrystallization processes, the strengthening is not in accord with models based on the development of very large dislocation densities (10/sup 13/ cm/sup -2/).

18594 **Development of a new hot-cracking test - The sigmajig.** Goodwin, G.M. (Materials Joining Group, Metals and Ceramics Div., Oak Ridge National Lab., Oak Ridge, TN). *Welding Journal (Miami);* **66**: No. 2, 33-S-38-S(Feb 1987). Contract AC05-84OR21400.

The development of a new hot-cracking test and its application to 12 heats of austenitic stainless steel are described. The test involves application of a transverse stress, sigma (hence the name), to a 50- x 50-mm (2- x 2-in.) square sheet specimen, followed by autogenous gas tungsten arc welding. As the preapplied stress is increased specimen by specimen, cracking eventually occurs. Testing to date has concentrated on 0.25-mm (0.01-in.) thick Types 304 and 316 stainless steel. Threshold stress values at the onset of cracking were found to range from 15 to 53 ksi (103 to 365 MPa). Ranking of the heats agrees completely with prior results from both the Lambert test and the ORNL Circular patch test, and it provides quantitative indices unavailable from the other tests. Data analyses indicate a dependence of cracking sensitivity on total sulfur plus phosphorus content for the Type 316 heats.

18595 **Advanced Research and Technology Development Fossil Energy Materials Program.** Judkins, R.R.; Bradley, R.A. (Metals and Ceramics Div., Oak Ridge National Lab., Building 4508, P.O. Box X, Oak Ridge, TN 37831-6098). pp 582-593 of Proceedings of the 4th annual Pittsburgh coal conference. Greensburg, PA; MEMS (1987). (CONF-870942—).

From 4. annual Pittsburgh coal conference; Pittsburgh, PA, USA (28 Sep 1987).

The Advanced Research and Technology Deelopment (AR and TD) Fossil Energy Materials Program is a multifaceted materials research and development program sponsored by the Office of Fossil Energy of the U.S. Department of Energy. The program is administered by the Office of Technical Coordination. In 1979, the Office of Fossil Energy assigned responsibilities for this program to the DOE Oak Ridge Operations Office (ORO) as the lead field office and Oak Ridge National Laboratory (ORNL) as the lead national laboratory. Technical activities on the program are divided into three research thrust areas: structural ceramic composites, alloy development and mechanical properties, and corrosion and erosion of alloys. In addition, assessments and technology transfer are included in a fourth thrust area. This paper provides information on the structure of the program and summarizes some of the major research activities.

18596 **Computer simulation of quenching uranium-0.75 weight per cent titanium alloy.** Ludtka, G.M.; Llewellyn, G.H.; Aramayo, G.A.; Siman-Tov, M.; Childs, K.W. (Martin Marietta Energy Systems, Inc., Oak Ridge Y-12 Plant, P.O. Box Y, Oak Ridge, TN 37831). pp 227-248 of Computer simulation of microstructural evolution. Srolovitz, D.J. Warrendale, PA; The Metallurgical Society Inc. (1986). (CONF-8510160—).

From ASM metals congress/TMS-AIME fall meeting; Toronto, Canada (13 Oct 1985).

A "QUENCH SIMULATOR" has been developed which uses finite difference heat transfer and finite element stress analysis techniques to predict the behavior of a metal during quenching. The actual nonlinear temperature- and microstructure-dependent physical, thermophysical, and mechanical properties are incorporated as input into the computer model as well as the continuous cooling transformation (CCT) behavior and heats of transformation of the alloy. The final output provides the transient temperature distribution, details the final residual profile, predicts and shows where distortion occurs, and maps out the microstructure distribution throughout the entire sample. These data are available in tabulated form, contour plots, or color-coded graphics. This analysis has been demonstrated on simple shapes for unalloyed uranium and the uranium-0.75 weight per titanium alloy which undergoes a martensite transformation and is quench-rate sensitive. The results of this study are discussed in detail in addition to other applications of this analysis approach which is generic in nature.

18597 **Alloy 316LN for low temperature structures: A summary of tensile and fracture data.** Reed, R.P.; Simon, N.J.; Purtscher, P.T.; Tobler, R.L. (Fracture and Deformation Div., National Bureau of Standards, Boulder, CO). pp 786-790 of Proceedings of the eleventh international cryogenic engineering conference. Klipping, G.; Klipping, I. Stoneham, MA; Butterworth Publishers (1986). (CONF-860437—).

From 11. international cryogenic engineering conference; Berlin, F.R. Germany (22 Apr 1986).

For structural use in superconducting magnet applications, alloy 316LN offers higher strength than 304LN with equivalent toughness. Nitrogen additions permit one to obtain a range of yield strength levels with little added cost. Tensile and fracture toughness data at 4 K are presented for a variety of 316 and 316LN alloys. The specimens were obtained from supplier in Japan, Europe, and the United States and were tested at NBS. Elastic-plastic fracture toughness was determined from J-integral measurements.

18598 **(AD-A—186401/6/XAB) Metallurgical processes in multi-component rare earth - transition-metal permanent-magnet alloys. Final report, 14 December 1983-30 April 1987.** Ray, A.E. (Dayton Univ., OH (USA)). Jun 1987. 11p. (UDR-TR—87-92). NTIS, PC A03/MF A01.

A primary objective of this research is to test and refine a model to describe the metallurgical behavior of Sm(Co,Fe,Cu,Zr) alloys and the complex relationships between the compositions, heat treatments, microstructures, and compositions of the phase observed, and the corresponding magnetic properties developed by the alloys. A second objective is to develop laboratory techniques and procedures for the processing of 2:17-type permanents magnet in order to be reasonably confident that observed variations in the magnetic and other physical properties measured would reflect intentional changes in compositional and heat-treating parameters. A third objective of developing higher-energy-product 2:17-type permanent magnets than were known at the beginning of the research effort was not accomplished.

18599 **(BNL—40448) Critical current densities of alloyed multifilamentary Nb_3Sn wires by the internal tin process.** Suenaga, M. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 8p. (CONF-8706125—22). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003485/JAW.

From Conference on advances in cryogenic engineering; St. Charles, IL, USA (14 Jun 1987).

Three types of the internal tin processed alloy (Ti and Ta) Nb_3Sn wires were studied for critical current densities J/sub c/ in a magnetic field range of 8 to 24 T at 4.2°K. In general, there was no consistent correlation between the values of J/sub c/ and the alloying element nor the filament size. However, it was shown that a very high current density (e.g., J/sub c/ = 350 A/mm^2) can be achieved if the transition to the normal state is very abrupt, i.e., n > 40 at H = 16 T. 15 refs., 6 figs., 1 tab.

18600 (CONF-871126—10) Magnetic correlations in amorphous Fe-Zr alloys. Rhyne, J.J.; Erwin, R.W.; Fernandez-Baca, J.A.; Fish, G.E. (National Bureau of Standards, Washington, DC (USA). Inst. for Materials Science and Engineering; Oak Ridge National Lab., TN (USA); Allied-Signal, Inc., Morristown, NJ (USA)). 1987. Contract AC05-84OR21400. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005847/JAW.

From 32. conference on magnetism and magnetic materials; Chicago, IL, USA (9 Nov 1987).

Results of high-resolution small-angle neutron scattering (SANS) studies on amorphous alloys of composition Fe/sub x/Zr/sub 100-x/ (x = 90, 91, 92) show that ferromagnetic correlations exist below T/sub c/, but that conventional long-range order is destroyed by competing exchange interactions. The transition temperatures drop with increasing iron concentration (T/sub c/ ≈226°K for $Fe_{90}Zr_{10}$ down to T/sub c/ ≈175°K for $Fe_{92}Zr_8$). Data taken at very low Q ($0.008A^{-1} < Q < 0.02\ A^{-1}$) provide evidence of relatively large (≈200 to ≈400 A) static spin clusters which do not disorder at T/sub c/. Superposed on this is an ordering with a second shorter length scale which shows a cusp (not divergent) at the bulk T/sub c/. The data were fitted to a combination of a Lorentzian and a power of a Lorentzian, the latter of which represents scattering from clusters with a Maxwellian distribution of sizes. 10 refs., 3 figs.

18601 (CONF-8703230—1) Electronic interactions in the rhodium/TiO/sub 2/ system. Sadeghi, H.R.; Henrich, V.E. (Yale Univ., New Haven, CT (USA). Dept. of Applied Physics). 1987. Contract AC02-81ER10830. 29p. (CONF-8705250—1). NTIS, PC A03; 3; GPO Dep. Order Number DE88005021/JAW.

From Metropolitan joint New York-New England Catalysis Societies spring symposium; New Haven, CT, USA (1 Mar 1987).

A variety of electron spectroscopic techniques have been used with model catalysts fabricated on single-crystal substrates to study charge transfer in the Rh/TiO/sub 2/ system. In order to avoid the morphological changes and encapsulation that occur when catalysts are reduced at high temperatures to induce SMSI (strong metal-support-interactrons), TiO/susb 2/b 2/ substrates have been reduced by inert gas ion bombardment prior to Rh deposition. Comparison of model catalysts prepared on reduced supports with those prepared on fully oxidized supports indicate that electronic charge is transferred from reduced Ti cations to Rh particles, resulting in a partially ionic Rh-Ti bond. The Rh-Ti bonding may provide a driving forcve for menencapsulation of the Rh but does not lead to a large scale suppression of the capacity of the Rhy to chemisorb CO. We also present the first direct evidence for modification of the valence levels of the Rh due to the presence of the encapsulating Ti suboxide moieties during SMSI. 39 refs., 9 figs.

18602 (CONF-8706103—6) Liquid alloys: New perspectives and challenges. Saboungi, M.L.; Leonard, S.R.; Johnson, G.K.; Price, D.L. (Argonne National Lab., IL (USA)). Dec 1987. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005935/JAW.

From NATO advanced study institute on alloy phase stability; Crete, Greece (14 Jun 1987).

In this paper, we will focus on one of many unusual liquid semiconducting alloys, K-Pb. The thermodynamic and electrical properties will be discussed and analyzed in terms of a disorder model introduced first by Wagner for crystalline semiconductors. The structure of the equiatomic alloy will be presented; interpretation of the first sharp diffraction peak in the total structure factor is based on the local structures in the crystalline phase and should be viewed as an example of the interrelation between the solid and liquid properties.

18603 (DOE/ER/45100—4) Theoretical studies of chemisorption and surface reactions on nickel and silicon: Progress report, June 15, 1987-June 14, 1988. Whitten, J.L. (State Univ. of New York, Stony Brook (USA)). 22 Jan 1988. Contract FG02-84ER45100. 11p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005820/JAW.

The research is part of a theoretical program on the structure of molecules adsorbed on solid surfaces and dissociative chemisorption with emphasis on transition metal substrates and electronic materials. An embedding theory for treating chemisorption on metals is being developed and applied to the reaction of hydrocarbon fragments and hydrogen coadsorbed on nickel and the chemisorption of water on nickel. The main emphasis of the work is on the energetics of adsorption as a function of surface site. The first phase of the nickel-hydrocarbon fragment project concerning the reaction CH + H = CH_2 on Ni(111) was completed this year. Detailed energetics and structural information are obtained for the CH, CH_2 and H species at the most stable sites on Ni(III) and for intermediate steps along the reaction pathway. The reaction producing CH_2 is exothermic, however, an energy barrier exists for the approach of H toward CH. Both CH and CH_2 are most strongly bound at three-fold adsorption sites on the (111) surface. Frequencies of H-, HC- and H_2C-surface vibrations and CH vibrations are calculated. Studies of the adsorption of C_6H_6 on Ni(111) show an upward tilt of the hydrogens (7.5° out of the carbon plane) occurs in the minimum energy geometry. The results are now being analyzed to determine the surface dipole and effect on benzene adsorption on the work function. Work on the recombination reaction of hydrogen on nickel was also started during this period. Studies of the fragmentation of CH_4 to produce adsorbed CH_3 + H on nickel are underway.

18604 (DOE/ER/45297—4) Competing interactions in metallic superlattices. Falco, C.M.; Makous, J.L.; Bell, J.A.; Bennett, W.R.; Zanoni, R.; Stegeman, G.I.; Seaton, C.T. (Arizona Univ., Tucson (USA)). 1987. Contract FG02-87ER45297. 7p. (CONF-8705168—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005344/JAW.

From Workshop on competing interactions and microstructures: statics and dynamics; Los Alamos, NM, USA (5 May 1987).

Metallic superlattices provide an excellent system to study in a controlled manner a variety of physical phenomena, including superconductivity, magnetism, and electrical transport properties. As will be discussed in this paper, changes in certain of these properties as a function of superlattice modulation wavelength Λ are found to be correlated with structural changes and elastic property anomalies. The propeties of two particular metallic superlattices, Cu/Nb and Mo/Ta, are discussed in this paper, as examples of how competing interactions manifest themselves in the physical properties of these superlattices. 15 refs., 3 figs.

18605 (IA—1427, pp 62) Cathodoluminescence study of CdTe substrates. Rotter, S.; Raizman, A.; Adler, E.; Cinader, G. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18606 (IA—1427, pp 64) Evaluation of CdTe substrates for epitaxy. Rotter, S.; Raizman, A.; Cinader, G. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18607 (IA—1427, pp 97-98) Magnetic properties of electrodeposited Co-W thin films. Admon, U.; Dariel, M.P.; Grunbaum, E.; Lodder, J.C. (Israel Atomic Energy Commission, Tel Aviv; Tel Aviv Univ., Israel; Technische Hogeschool Twente, Eschede, Netherlands. Afdeling Electrotechnick). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18608 (INIS-mf—11619) Self-diffusion in amorphous FeZr alloys. Pfahler, K. (Stuttgart Univ. (Germany, F.R.). Fakultaet 12 - Physik). 25 Feb 1987. 85p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752243/JAW.

The thesis reports on self-diffusion investigations on Fe and Zr in several amorphous FeZr alloys by means of the radiotracer method. Alloys were produced by melt spinning. It is found that for a certain temperature the diffusion coefficient decreases with time of glowing; finally, it reaches a fixed value which depends on temperature, but no longer on time. For the relaxed amorphous alloys diffusion activation enthalpies are found. (BHO).

18609 (LBL—24552) Microstructure and magnetization reversal of iron/rare earth/boron permanent magnets. Ramesh, R. (Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 229p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88005760/JAW.

An investigation of the microstructure and details of magnetization reversal of the new class of permanent magnets, Fe-Nd-B, was conducted. The microstructure consists of almost-defect-free grains of matrix $Nd_2Fe_{14}B$ surrounded by a Nd-rich, oxygen stabilized, fcc phase. A third phase, Fe_4NdB_4, along with the rare earth sesquioxide was infrequently observed as isolated grains. It was shown that the magnet behaves as a nucleation-controlled magnet, i.e., the magnetization reversal is controlled by the domain wall nucleation step. Since the interiors of the matrix grains are defect-free, domain wall nucleation occurs due to defects at the grain boundaries and two-phase interfaces. One possible defect is oxygen. The effect of post-sintering heat treatments upon the intrinsic coercivity and energy product has been rationalized based upon the above observations. Increase in the cooling rate after sintering leads to a decrease in the intrinsic coercivity due to the effect of quenching stresses, caused by thermal expansion mismatch at the fcc phase-matrix interface. Thus, the combined effect of oxygen and the quenching stresses causes a large reduction in intrinsic coercivity and energy product. A magnetization reversal model has been proposed, which incorporates the effect of quenching stresses also. Predictions of the model agree with the effect of temperature and composition on the intrinsic coercivity and anisotropy field. Lorentz electron microscopic observations suggest that domain walls interact strongly with grain boundaries and the grain boundary fcc phase when they are parallel to the microstructural feature. Inclusions of size below 500A have been observed to pin domain walls, thus suggesting a possible mechanism for improving the magnetic properties. Further improvement in the intrinsic coercivity and energy product can come about only by making domain wall nucleation more difficult.

18610 (PNL-SA—14918) Adsorption of H_2O on annealed and damaged iron. Baer, D.R.; Jones, R.H. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 15p. (CONF-871125—20). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005153/JAW.

From 34. national vacuum symposium and topical conference; Anaheim, CA, USA (2 Nov 1987).

The tips of advancing cracks are highly strained and may adsorb atoms or molecules from gaseous or liquid environments at rates different from unstrained surfaces. The influences of stress and sputter damage have previously been investigated for H_2S adsorption on iron, and this paper reports the extension of the work to H_2O on iron. Auger electron spectroscopy (AES) and x-ray photoelectron spectroscopy (XPS) examination of water adsorption on polycrystalline and (110) iron show that the saturation coverage of oxygen is not altered by ion beam damage, but that the adsorption rate can be increased by more than a factor of ten. These results are similar to those found for H_2S and have been interpreted in terms of a precursor adsorption model. 2 figs., 1 tab.

18611 (RFP—4027) Tritium permeation in passivated 304L stainless steels. Rising, T.L. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1986. Contract AC04-76DP03533. 5p. (CONF-8610378—1). NTIS, PC A02. Order Number DE88005146/JAW.

From Rockwell corrosion conference: corrosion prevention and control; Anaheim, CA, USA (8 Oct 1986).

Tritium permeation is controlled by surface permeation (e.g., cleaning, Pd coating). Tritium at the surface is disassociated. Various 304-L ss after various treatments were characterized, and tritium permeation studies were carried out at Los Alamos. Results were used to order the passivation treatments with regard to permeation resistance.

18612 (UCRL—94934) The influence of liquid metal infiltration on the superconducting characteristics of niobium nitride. Summers, L.T.; Miller, J.R.; Strum, M.J.; Weimer, R.J.; Kizer, D.E. (Lawrence Livermore National Lab., CA (USA); Cordec Corp., Lorton, VA (USA); Material Concepts, Inc., Columbus, OH (USA)). 12 Jun 1987. Contract W-7405-ENG-48. 10p. (CONF-8706125—23). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004004/JAW.

From Conference on advances in cryogenic engineering; St. Charles, IL, USA (14 Jun 1987).

We prepared a fully stabilized, multifilamentary, NbN superconductor using a combination of physical vapor deposition of NbN on graphite fibers followed by liquid metal infiltration using copper or aluminum. The resulting superconductor is in a finely divided multifilamentary form, embedded in a matrix of conductive copper or aluminum. The geometry provides high stability to flux jumps and high quench protection. The effects of liquid metal infiltration and process variables on the electrical properties of NbN have been investigated. Critical current vs field, and stabilizer residual resistivity ratio are discussed as well as the effect of liquid metal infiltration on NbN layer performance.

18613 (EGG-MS—7734) Experimental and theoretical methods for investigating helium effects in rapidly solidified metals. Wright, R.N.; Van Siclen, C.D. (EG and G Idaho, Inc., Idaho Falls (USA)). Jul 1987. Contract AC07-76ID01570. 18p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005542/JAW.

Experimental and theoretical methods available for investigating helium-defect interactions in rapidly solidified materials are considered. Transmission electron microscopy and positron annihilation appear to be the most useful experimental techniques. The two techniques are generally complementary since the upper limit of resolution using positron annihilation is approximately of the scale where transmission microscopy becomes readily applied. The recently developed embedded atom method appears well suited to modeling helium-defect interactions. 35 refs., 3 figs.

18614 (IA—1427, pp 107) Characterization of the oxidation of various metals in high temperature water vapors. Rabinovitz, E.; Stern, A.; Raveh, A.; Herrman, B. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18615 (INIS-BR—937) Study of the pitting and repassiv,tion corrosion potential of zicaloy-4 halides solutions at 25/sup 0/C and several pH . Gardiazabal, J.I.; Cordova, R.; Gomez, H.; Layana, G.; Schrebler, R. (Associacao Brasileira de Corrosao, Rio de Janeiro). 1987. 10p. (In Spanish). (CONF-8705180—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701474/JAW.

From 14. national seminar of corrosion; Sao Paulo, Brazil (11 May 1987).

The electrochemical behaviour of Zircaloy-4 electrode in chloride, bromide and iodide acid solution was investigated at 25/sup 0/C employing stationary, quasi-stationary and potentiodynamic techniques. The results show that the pitting and repassivation potentials are independent on pH but both are dependent on halice concentration, following linear relation ships in these cases. It is also possible to correlate the pitting potential with the ionic radius of the anions, allowing thus to establish an order in their agressive properties. This order was extrapolated for fluoride ion and further experimental measurements show that the corrosion potential of Zircaloy-4 in acid or neutra solution of this ion (which undergoes

active dissolution) is coincident with that predicted from the Ep v/ s ionic radius determined for the other halides.

18616 (KFK—4177, pp 363-386) **Use of an electro-chemical process for corrosion testing of different quality materials no. 1.4306 in nitric acid.** Simon, R.; Schneider, M.; Leistikow, S. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Material- und Festkoerperforschung). Apr 1987. (In German). NTIS (US Sales Only), PC A23/ MF A01. Order Number DE88751937/JAW. (PWA—89/ 86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

A typical appearance of corrosion in austenitic steels, which are used in reprocessing plants as container and construction materials, is intercrystalline corrosion at high anodic potentials, grain decomposition and the attack on widened grain boundaries stimulated by corrosion products. For safety reasons, the materials used in the nitric acid Purex process area are subjected to extensive corrosion tests. A particularly suitable process for testing materials for chemically and thermally highly stressed parts of the plant is the standard HUEY test standardised on by ASTM and Euronorm, which, however, is time, cost and labour intensive. The test routine introduced here, anodic polarisation at +1250 mV (nhe) makes it possible to give comparative information on the liability to intercrystalline corrosion of Austenitic steels of similar composition after a much shorter time. The principle consists of an electrochemical simulation of the actual potential causing intercrystalline corrosion of the group of materials. While the results are comparable with those of the HUEY test, the necessary test time is shortened from 5x48 hours to 1 hour. The evaluation of the surface and structure attack, which has occurred is done by observation of the measured electrical, metallographic and gravimetric data. The test routine described here offers an alternative (at least for the purpose of pre-selection) with a value equivalent to a standard HUEY test, but with greatly reduced amounts of time and work. However, it requires electrochemical pre-examination of the groups of materials of interest in nitric acid to determine the critical anodic potentials, due to the constant effects of which it is possible to shorten the test period.

18617 **(ND-R—1270(R)) Constant load and constant displacement stress corrosion in simulated water reactor environments.** Lloyd, G.J. (UKAEA Risley Nuclear Power Development Establishment). Feb 1987. 14p. (CONF-8505273—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751914/JAW.

From 2. International Atomic Energy Agency specialists' meeting on subcritical crack growth; Sendai, Japan (15 May 1985).

The stress corrosion behaviour of selected water reactor constructional materials, as determined by constant load or constant displacement test techniques, is reviewed. Experimental results obtained using a very wide range of conditions have been collected in a form for easy reference. A discussion is given of some apparent trends in these data. The possible reasons for these trends are considered together with a discussion of how the observed discrepancies may be resolved.

18618 **(ORNL/Sub—83-43336/01) Erosion in dual-phase microstructures: Final report.** Kosel, T.H. (Notre Dame Univ., IN (USA). Dept. of Materials Science and Engineering). 7 Dec 1987. Contract AC05-84OR21400. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004507/JAW.

This project was designed to provide a systematic investigation of the effects of microstructural variables on particle impact erosion of two-phase metallic alloys containing large second-phase particles (SPPs). Commercial alloys that contain large hard carbides, such as high Cr-Mo white cast irons and Stellite alloys are known to be highly abrasion resistant. Since there are many similarities between abrasion and erosion, it was felt that a systematic examination of the erosion behavior of such alloys would be useful, especially since existing literature on the subject seemed to indicate that they offered little advantage in erosion. Work was divided into two major sections, on erosion of commercial alloys and of model alloys having artificial SPPs like Al_2O_3 dispersed in a Cu matrix. The model alloys allowed control of SPP size and second-phase volume fraction (SPVF), and permitted experiments comparing the erosion rates of the dispersed alloys with those of the pure phases. Under the wide range of erosion conditions investigated, this type of alloy offered no significant improvement of erosion resistance over simple, inexpensive low-carbon steels. This was concluded to be the result of the phenomenon of edge spalling from the edges of the SPPs, which was investigated in some detail. 18 refs., 29 figs., 4 tabs.

18619 **(ORNL/TM—10602) On the kinetics of the aluminum-water reaction during exposure in high-heat flux test loops: 1, A computer program for oxidation calculations.** Pawel, R.E. (Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006150/JAW.

The "Griess Correlation," in which the thickness of the corrosion product on aluminum alloy surfaces is expressed as a function of time and temperature for high-flux-reactor conditions, was rewritten in the form of a simple, general rate equation. Based on this equation, a computer program that calculates oxide-layer thickness for any given time-temperature transient was written. 4 refs.

18620 **(PB—88-130398/XAB) Zirconium alloy waterside corrosion. Research note.** Lunabba, R. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Metallilaboratorio). 1987. 135p. (VTT/RN—729). NTIS, PC E06/MF A01.

In the development of zirconium alloys for nuclear service, one of the main tasks has been to improve the corrosion properties. Subsequently, the corrosion of zirconium alloys has been studied extensively since the beginning of the commercial nuclear era, resulting in numerous reports and articles. The aim of this work has been to review the recent trends in opinions on the corrosion mechanisms, the trends in alloy development, and the in-reactor experience gained up till now. Some of the properties of the zirconium oxide film have also been given; the properties can be used as input data in corrosion models. Among zirconium alloys, mainly Zircaloy-2, Zircaloy-4, Zr-1%Nb and Zr-2.5%Nb, the only alloys of commercial importance in nuclear service, are discussed. The development of water-cooled power plants seems not to go into areas where experimental alloys would be superior compared to traditional alloys.

18621 **Corrosion-resistant amorphous metallic films of Mo/sub 49/Cr/sub 33/B/sub 18/ alloy.** Ramesham, R.; DiStefano, S.; Fitzgerald, D.; Thakoor, A.P.; Khanna, S.K. (Jet Propulsion Lab., California Institute of Technology, Pasadena, CA 91109). *Journal of the Electrochemical Society;* **134**: No. 9, 2133-2136(Sep 1987).

Amorphous metallic films of Mo/sub 49/Cr/sub 33/B/sub 18/ have been deposited onto glass and quartz substrates by the magnetron sputter quenching technique. The amorphous nature of the as-deposited films was confirmed by their diffuse x-ray diffraction patterns. The crystallization temperature of the as-deposited films was 590°C, according to the differential scanning calorimetry studies. Surface texture and cross-sectional features of the coatings were examined by scanning electron microscopy. Electron microprobe analysis was used to determine the chemical composition of the films. Chemical compositional uniformity of the as-deposited amorphous metallic films was verified by secondary ion mass spectrometry. As-deposited films exhibited microhardness of the order of 600-850 HV. Kinetics of corrosion of the alloy films in H/sub 2/ SO/sub 4/ (1N) solution has been studied by potentiodynamic and galvanostatic techniques. As-deposited amorphous films exhibited corrosion current density three orders of magnitude less than the corrosion current density of 304 stainless steel in H/sub 2/SO/sub 4/ (1N) solution. A reaction mechanism at the corrosion potential is proposed.

18622 **(CEA-R—5389) Study of point defects in bismuth.** Bois, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)). Mar 1987. 189p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87753176/JAW.

Single crystalline samples of bismuth, pure and n or p - doped by adding tellurium or tin, were electron irradiated at low temperature (4.2 K and 20 K). In the energy range 0.7 - 2.5 MeV, a displacement threshold energy of 13 eV and an athermal recombination volume of 150 atomic volumes were determined. Joint measurements of resistivity, magnetotransport and positron annihilation enabled to precised the nature of the annealing stages: 40-50 K, free migration of interstitials; 90-120 K long range migration of vacancy. Point defects have according to their nature a different effect on the electronic properties of bismuth: isolated Frenkel pairs are globally donnors with a charge of + 0.16 e- and the vacancy is donnor, which seems to attribute to it a negative formation volume. A simple model with non-deformating bands is no longer sufficient to explain the behaviour under irradiation: one has to take into account an acceptor level with a charge of - 0,27 e-, linked to the cascade-type defects and resonating with the valence band. It's position in the band overlap and it's width (8 meV) could be precised. In first approximation this coupling with less mobile carriers does not affect the simple additive rule which exists for relaxation times. Some yet obscure magnetic properties seem to be linked to this defect level.

18623 (INIS-GB—90, pp 135-140) **Discussion.** 1987. Central Electricity Generating Board, London (UK); Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.. Order Number DE87752852/JAW. (CONF-8609307—).

From Symposium on radiation-induced sensitization of stainless steels; Berkeley, UK (23 Sep 1986).

The paper is a discussion of the work presented at the symposium on "radiation-induced sensitisation of stainless steels", Berkeley, United Kingdom, 1986. The purpose of the symposium was to discuss the mechanism for inter-granular corrosion of 20%Cr/25%Ni/Nb stainless steel cladding of AGR fuel, following irradiation. The programme included contributions on the theory of radiation-induced segregation, on experimental studies by means of corrosion tests, on the analytical electron microscopy to measure compositional profiles at grain boundaries and on observations of such profiles in neutron, heavy ion and electron irradiated steels. (U.K.).

18624 **(INIS-mf—11628) Pion-myon channeling in metals and semiconductors.** Rempp, H. (Stuttgart Univ. (Germany, F.R.). Fakultaet 12 - Physik). 19 Feb 1986. 122p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752249/JAW.

The aim of the present thesis is the investigation of pions in several crystals under varying conditions. In chapter 2 channeling is outlined, in chapter 3 the method is described for $\mu/sup +/$, chapter 4 presents the crystals used, chapters 5 and 6 measuring method and experiment. The results are compiled (chapter 7) and discussed (chapter 8). (BHO).

18625 **(JINR-R—13-86-860) Thin film surface treatment by pulsed electron beam.** Vavra, I.; Korenev, S.A. (Slovenska Akademia Vied, Bratislava, Czechoslovakia. Elektrotechnicky Ustav; Joint Inst. for Nuclear Research, Dubna, USSR. Dept. of New Acceleration Methods). (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of New Acceleration Methods). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701508/JAW.

Submitted to the journal Zh. Tekh. Fiz. .

A method of thin film surface treatment by the pulsed electron beam fusion is proposed and demonstrated in the paper. The results of the method for the film specimen of the superconductor structure A/sub 15/(Nb/sub 3/Ge) are given. It is shown that the treatment results, sufficiently improving the surface structure, don't make worse the film superconductor parameters. The results of the film diffraction analysis are given too. 10 refs.; 3 figs.

18626 **(LBL—24568) Flicker (1/f) noise in copper films due to radiation-induced defects.** Pelz, J.P. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 118p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005761/JAW.

Changes were measured in the 1/f noise and resistivity in polycrystalline Cu films due to defects induced by 500 keV - 1.1 MeV electrons or 1 MeV Kr^+ ions. 500-keV electrons increased the voltage noise level in the films by more than an order of magnitude, while the resistivity increased by at most 10%. When the films were annealed at higher temperatures, both the 1/f noise and the resistivity were reduced; however, at lower annealing temperature, the fractional reduction in the induced noise was substantially more than in the added resistivity. This suggests that a large fraction of the induced noise may be generated by mobile added defects that are more readily annealed than the majority of the added defects. The temperature dependence of the noise after irradiation and partial annealing indicated that the induced noise was thermally activated in a manner consistent with the Dutta-Dimon-Horn model. Isolated defects created by 1.1-MeV electrons produced higher noise levels than clustered defects resulting from 1-MeV Kr^+ irradiation. Isolated In and Be impurities in Cu are known to trap radioinduced interstitial defects. Data on several films indicate that the induced 1/f noise is not sensitive to the type and quantity of interstitial traps. A simple local interference model is presented, which uses calculations by Martin to estimate the 1/f noise magnitude generated by moving defects. This model can account for the induced noise, with enough mobile defects. Several simple models are examined concerning the defects responsible for the induced noise. A model which attributes the noise to the motion of vacancy-type defects close to surfaces, grain boundaries, or dislocations is most consistent with experiment and theory.

18627 **(NIIAR—28(709)) Annealing effect on restoration of irradiation steel properties.** Vishkarev, O.M.; Kolesova, T.N.; Myasnikova, K.P.; Pecherin, A.M.; Shamardin, V.K. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701399/JAW.

The effect of temperature and annealing time on the restoration of properties of the 15Kh2NMFAA and 15Kh2MFA steels after irradiation at 285 deg with the fluence of 6x10/sup 23/ neutr/m/sup 2/ (E>0.5 MeV) is studied. Microhardness (H/sub μ/) restoration in the irradiated 15Kh2NMFAA steel is shown to start from 350 deg C annealing temperature. The complete microhardness restoration is observed at the annealing temperature of 500 deg C for 10 hours. 8 refs.; 3 figs.; 4 tabs.

18628 **(UCRL—97801) Database of average-power damage thresholds at 1064 nm.** Rainer, F.; Hildum, E.A.; Milam, D. (Lawrence Livermore National Lab., CA (USA)). 14 Dec 1987. Contract W-7405-ENG-48. 22p. (CONF-8710165—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004352/JAW.

From Boulder damage symposium; Boulder, CO, USA (26 Oct 1987).

We have completed a database of average-power, laser-induced, damage thresholds at 1064 nm on a variety of materials. Measurements were made with a newly constructed laser to provide design input for moderate and high average-power laser projects. The measurements were conducted with 16-ns pulses at pulse-repetition frequencies ranging from 6 to 120 Hz. Samples were typically irradiated for time ranging from a fraction of a second up to 5 minutes (36,000 shots). We tested seven categories of samples which included antireflective coatings, high reflectors, polarizers, single and multiple layers of the same material, bare and overcoated metal surfaces, bare polished surfaces, and bulk materials. The measured damage threshold ranged from < 1 J/cm^2 for some metals to > 46 J/cm^2 for a bare polished glass substrate. 4 refs., 7 figs., 1 tab.

18629 **Excimer laser processing of crystalline iron-boron alloys.** McCamy, J.; Pedraza, A.J.; Lowndes, D.H. (Dept. of Materials Science and Engineering, The Univ. of Tennessee, Knoxville, TN 37996-2200). pp 203-210 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Crystalline Fe-B alloys in the concentration range of 5-25 at. pct. boron were processed by slightly (— 5%) overlapping single pulse XeCl excimer laser. The influence of the initial microstructure and phases upon the structure that results after laser processing (LP) were studied. The specimens were made by a rapid solidification procedure that permits readily glass-forming alloys to be obtained with structures ranging from fully amorphous to fully crystalline. The technique is briefly described. Two crystalline specimens of Fe-20 pct. boron, one in the as-cast condition and the other annealed, were laser treated. While the melted layer of the former was amorphous, the latter remained crystalline, exhibiting a similar phase content as before irradiation. Observations of both samples by scanning electron microscopy (SEM) prior to LP revealed a difference in particle size of one order of magnitude. A mathematical model of diffusion is developed for studying the homogenization process. It is concluded that the time for diffusion in the liquid state in the sample containing the larger particles is insufficient for homogenization to occur. Similar results regarding the influence of particle size were obtained with all the other samples.

18630 **The roles of energetic displacement cascades in ion beam modifications of materials.** Averback, R.S.; Kim, S.J.; De la Rubia, T.D. (Argonne National Lab., Argonne, IL 60439). pp 399-410 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—). Contract W-31-109-ENG-38.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The roles of energetic displacement cascades are ubiquitous in the fields of radiation damage and ion beam modifications of materials. These roles can be described on two time scales. For the first, which lasts ≈ 10/sup -11/ s, small cascade volumes are characterized by large supersaturations of point defects, structural disorder, and energy densities in excess of some tenths of eV's per atom. During this period, the system can be driven far from equilibrium with significant rearrangement of target atoms and the production of Frenkel pairs. Experimental studies of ion beam mixing in conjunction with molecular dynamics computer simulations, have contributed largely toward understanding these dynamic cascade processes. At later times, the microstructure of the material evolves as cascades begin to overlap, or at elevated temperatures, point defects migrate away from their nascent cascades. It is shown how the primary state of damage in cascades influences this microstructural development. Examples involving radiation-enhanced diffusion and ion-induced amorphization are discussed.

18631 **Temperature dependence of amorphization above 10K in the CuTi intermetallic compound under electron irradiation.** Koike, J.; Luzzi, D.E.; Meshii, M.; Okamoto, P.R. (Dept. of Materials Science and Engineering, Northwestern Univ., Evanston, IL 60201). pp 425-430 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The critical dose required to amorphize the crystalline compound CuTi during irradiation with 1 meV electrons has been investigated from 10 to 288 K. The results show that above a critical temperature (Tc) of about 185 K, CuTi remains crystalline and only defect clusters are formed. Below Tc, amorphization occurs with no observable cluster formation. The critical dose for amorphization was found to be temperature dependent below Tc: as the irradiation temperature increases, a higher dose is required to induce amorphization. This observation supports the concept that Tc corresponds to the vacancy migration temperature. Below Tc, interstitial migration may contribute to the observed reduction in the amorphization rate with increasing temperature.

18632 **Formation of submicron metastable phase structures in alloys with focused electron or proton beams.** Lam, N.Q.; Okamoto, P.R.; Leaf, G.K. (Argonne National Lab., 9700 S. Cass Ave., Argonne, IL 60439). pp 523-528 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—). Contract W-31-109-ENG-38.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Recent theoretical and experimental studies of radiation-induced segregation in alloys under irradiation with focused charged-particle beams have shown that point-defect currents generated by axial and radial displacement-rate gradients can cause significant redistribution of the alloying elements within the irradiated zone. In the case of irradiation of thin films with highly-focused electron beams, two important features have been established experimentally: (i) the diameter of the local region in which the alloy composition and phase are modified is practically equal to the beam diameter, and (ii) the time required to produce a given change in the alloy composition in the center of the irradiated zone decreases rapidly with beam diameter. The theoretical modeling indicates that these features will also be observed in semi-infinite alloys bombarded with focused proton beams. However, in this case, the spatially-nonuniform defect production in both the axial and radial directions renders the compositional redistribution more complex. The present work shows that the ability to locally modify the alloy composition by focused electron or proton beams may offer a new method for producing local regions of controlled compositions and microstructures on a submicron scale. The results of our model calculations and experimental studies are presented to demonstrate the feasibility of this novel technique.

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REFER ALSO TO CITATION(S) 17558, 17560, 17560, 17784, 17881, 18488, 18532, 18576, 18595, 18628, 18630, 18663, 19983, 20007, 20008, 20246, 20497, 20498, 20499

18633 (IA—1427, pp 49) **Characteristics of RF silicon carbide films.** Raveh, A.; Inspektor, A.; Carmi, U.; Avni, R. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18634 **(RFP—4061) Films of rare earth oxides formed by electron-beam evaporation.** Adams, R.O.; DiGiallonardo, A.; Nordin, C.W. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1987. Contract AC04-76DP03533. 17p. (CONF-870388—18-Draft). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005279/JAW.

From International conference on metallurgical coatings; San Diego, CA, USA (23 Mar 1987).

The application for the rare earth oxides of interest here is the protection of steel crucibles and molds from attack by molten plutonium. In this application the oxide film needs only to be adherent, free from large cracks and tenacious through thermal shocks. It was shown that an erbium oxide film could provide the necessary protection, but the optimum characteristics were not established. Yttrium oxide films provide the same protection but the film is not as rugged as the erbium oxide film. Films of erbium and yttrium oxides have been produced and examined. 8 figs.

18635 **(SAND—87-1309C) Thermal nitridation of Si(100) using hydrazine and ammonia.** Rogers, J.W. Jr.; Blair, D.S.; Peden, C.H.F. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 13p. (CONF-8711124—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005158/JAW.

From Topical conference on deposition and growth: limits for microelectronics; Anaheim, CA, USA (2 Nov 1987).

Miniaturization of electronic devices has created an increasing demand for very thin insulator films. Silicon nitride films,

widely used in the semiconductor industry for their passivating and/or dielectric properties, are considered an important key to further miniaturization. Direct thermal nitridation of the silicon by ammonia at temperatures above 1173°K is currently being examined as an alternate to the commonly used method in industry of chemical vapor deposition. However, high solid-state diffusion rates of Si and N at 1173°K cause degradation of the electrical properties and limit the minimum obtainable nitride layer thickness. The previously reported high reactivity of hydrazine at low temperature was exploited in an attempt to nitride Si at lower temperatures and thereby reduce solid-state diffusion and form an abrupt insulator-semiconductor interface. X-ray photoelectron spectroscopy (XPS) was used to investigate the direct thermal nitridation of Si(100) using hydrazine and ammonia as nitrogen sources. The rate of film formation between 873 and 1173°K was markedly higher at a given temperature using hydrazine. Over this temperature range, the measured XPS N(ls) binding energy using either nitrogen source remained constant at 398.1 eV during nitridation suggesting that the nitride films were chemically similar. In addition, no oxygen was detected in the films. The increased rate of nitride formation using hydrazine is attributed to the lower energy required for dissociative adsorption relative to ammonia. 18 refs., 2 figs.

18636 **(SAND—87-2922C) A hydroxycarbonate route to superconductor precursor powders.** Voigt, J.A.; Bunker, B.C.; Doughty, D.H.; Lamppa, D.L.; Kimball, K.M. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-871124—35). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003638/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

A precipitation process is described for the preparation of powders that can be thermally decomposed to form high critical temperature superconductors such as $YBa_2Cu_3O_7$. In the process, a cationic solution (a concentrated chloride or nitrate solution) is instantaneously mixed with an anionic solution (a mixture of tetramethylammonium hydroxide and carbonate) to produce a metal-hydroxycarbonate precipitate having the metal stoichiometry of the desired superconducting oxide. The calcining and sintering of the precipitates is critical in controlling the structural integrity and morphology of the superconducting cermaics made from the chem-prep powders, as well as controlling superconducting properties. Under appropriate conditions, high density (>95%) materials that exhibit good superconducting characteristics can be prepared with the chem-prep powders. 6 refs., 3 figs.

18637 **(DOE/ER/45191—4) [Perturbed angular correlations in zirconia ceramics: Third annual progress report].** Gardner, J.A. (Oregon State Univ., Corvallis (USA)). 1987. Contract FG06-85ER45191. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004117/JAW.

Research on zirconia and yttrium alloys is presented. Perturbed Angular Correlations (PAC) have been made with ^{181}Hf, ^{111}In as probes. Also, PAC spectra of $^{181}Hf/Ta^{181}$ in cubic zirconia/yttria are presented at several temperatures. Information is also presented on initial experiments of PAC research on pure zirconia using In/Cd. 12 refs., 6 figs. (CS)

18638 **(EGG-M—11187) Ultrasonic characterization of non-uniform porosity distributions in SiC ceramic.** Telschow, K.; Walter, J.; Kunerth, D. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 15p. (CONF-870691—10). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004814/JAW.

From Review of progress in quantitative NDE; Williamsburg, VA, USA (21 Jun 1987).

During fabrication of monolithic ceramic silicon carbide very localized regions of high porosity can be produced. This porosity often consists of a very large density of small pores. Even at wavelengths considerably larger than the pore size, significant effects can be observed in the propagation of ultrasonic waves through these materials. These effects include attenuation, scattering and changes in wave velocity and anomalous wave amplitude modulation due to the non-uniformity of the porosity distribution. This paper describes the characterization of such a porosity distribution in SiC utilizing these ultrasonic techniques and their correlation with x-ray and optical microscopy measurements. Significant effects were observed due to the nonuniformity of the porosity which resulted in enhancement of signal amplitudes greatly exceeding attenuation effects due to scattering. This unexpected result proved to be most sensitive to the boundaries of the porosity distribution and provided one of the best techniques for delineating its extent. 8 refs., 6 figs.

18639 **(LBL—24139-Rev.) The structure and properties of twin boundaries in superconducting $YBa_2Cu_3O_7$.** Zandbergen, H.W.; Gronsky, R.; Chu, M.Y.; DeJonghe, L.C.; Holland, G.F.; Stacy, A. (Lawrence Berkeley Lab., CA (USA)). Jan 1988. Contract AC03-76SF00098. 10p. (CONF-871124—17-Rev.). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005431/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

A relationship between preparation procedures, diamagnetic yield and twin densities in $YBa_2Cu_3O_7$ has been established. Decreasing the calcination temperature causes an increase in the formation of [100] 90° rotation twins and a corresponding change in the c/a ratio. At sufficiently high densities of these twins, the tetragonal structure is stabilized. Correlations between c/a ratio and twin densities with the critical temperature and diamagnetic yield are reported.

18640 **(N—88-11838) Structure and grain coarsening during the processing of engineering ceramics.** Shaw, N.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Nov 1987. 178p. (NASA-TM—100235; E—3860; NAS—1.15:100235). NTIS, PC A09/MF A01.

Studies have been made of three ceramic systems (Al_2O_3, Y_2O_3/MgO, and SiC/C/B), both to explore a surface area/density diagram approach to examining the coarsening processes during sintering and to explore an alternative coarsening parameter, i.e., the grain boundary surface area (raising it at a given value of the density) and not the pore surface area; therefore, pinning of the grain boundaries by solid-solution drag is the only function evidenced by these results. The importance of such pinning even at densities as low as 75% of theoretical is linked to the existence of microstructural inhomogeneities. The early stages of sintering of Y_2O_3 powder have been examined using two techniques, BET surface area analysis and transmission electron microscopy. Each has given some insight into the process occurring and, used together, have provided some indication of the effect of MgO on coarsening during sintering. Attempts to further elucidate effects of MgO on the coarsening behavior of Y_2O_3 by the surface area/density diagram approach were unsuccessful due to masking effects of contaminating reactions during sintering and/or thermal etching. The behavior of the undoped SiC which only coarsens can be clearly distinguished by the surface area/density diagram from that of SiC/C/B which also concurrently densifies. Little additional information was obtainable by this method due to unfavorable sample etching characteristics. The advantages, disadvantages, and difficulties of application of these techniques to the study of coarsening during sintering are discussed.

18641 **(N—88-12106) Flaw imaging and ultrasonic techniques for characterizing sintered silicon carbide.** Baaklini, G.Y.; Abel, P.B. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). Aug 1987. 21p. (NASA-TM—100177; E—3753; NAS—1.15:100177; CONF-870856—). NTIS, PC A03/MF A01.

From Conference on nondestructive testing of high performance ceramics; Boston, MA, USA (25 Aug 1987).

The capabilities were investigated of projection microfocus x-radiography, ultrasonic velocity and attenuation, and reflection scanning acoustic microscopy for characterizing silicon carbide specimens. Silicon carbide batches covered a range of densities and different microstructural characteristics. Room temperature, four point flexural strength tests were conducted. Fractography was used to identify types, sizes, and locations of fracture origins. Fracture toughness values were calculated from fracture strength and flaw characterization data. Detection capabilities of radiography and acoustic microscopy for fracture-causing flaws were evaluated.

Applicability of ultrasonics for verifying material strength and toughness was examined.

18642 **(SAND—87-3036C) Advances in x-ray line profile analysis to determine microstructure information about ceramics.** Zhang, Y.; Stewart, J.M.; Hubbard, C.R.; Morosin, B. (Maryland Univ., College Park (USA). Dept. of Chemistry; National Bureau of Standards, Washington, DC (USA); Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-8711115—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003938/JAW.

From 18. international conference on ceramic powder processing sciences; Orlando, FL, USA (1 Nov 1987).

In order to obtain microstructural information on many ceramic materials by x-ray diffraction line broadening analysis, both separation of overlapping lines and accurate assessment of the broadened and inherent instrumental line profiles are necessary. A profile fitting code has been developed to overcome the difficulties usually encountered when applying line profile analysis to ceramics with overlapping x-ray diffraction lines. After the separation of the overlapping lines, the usual procedure for determining the crystallite size and microstrain information is employed. The results on the peak separation by using the profile fitting code as well as the results of the size and strain for shock-modified monoclinic ZrO_2 are given as examples of the application of x-ray powder diffraction profile analysis. Such a procedure should be useful for assessing similar microstructural information on other ceramic materials. 7 refs., 5 figs.

18643 **On a minimum grain size for domain formation in lanthanum-modified lead titanate ferroelectric ceramics.** Demczyk, B.G.; Khachaturyan, A.G.; Thomas, G. (Dept. of Materials Science and Mineral Engineering, Univ. of California, and Materials and Molecular Research Div., Lawrence Berkeley Lab., Berkeley, CA 94720). *Scripta Metallurgica;* 21: No. 7, 967-970(1987). Contract AC03-76SF00098.

When cubic lead titanate, point group m3m, is cooled below its Curie point, it transforms into 100>, becoming tetragonal, point group 4mm. This is the ferroelectric state. In order to relieve the transformation strain, twins (ferroelectric domains) form, with {101} habit. A critical grain size for twinning has also been found using transmission electron microscopy. The experimentally observed minimum grain size (<0.3 μm) is consistent with values derived from a balance of the cubic to tetragonal elastic strain and twin surface energies. The samples under consideration were lanthanum-modified lead titanate, Pb/sub 0.7/La/sub 0.2/O/sub 3/ + 0.1 PbO, prepared by sintering.

18644 **(DOE/ER/45167—7) Theory and experiments of fracture in cyclic compression: Single phase ceramics, transforming ceramics and ceramic composites: Annual report for the period ending July 31, 1987.** Suresh, S.; Brockenbrough, J.R. (Brown Univ., Providence, RI (USA). Div. of Engineering). 28 Aug 1987. Contract FG02-84ER45167. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005792/JAW.

We present experimental results and constitutive models aimed at developing the framework for a general theory of compression fatigue in notched brittle solids. Firstly, the results of a recent constitutive model for microcracking brittle solids in cyclic compression are briefly summarized in the light of new experimental information on compression fatigue. Next, an experimentally-substantiated, generalized constitutive formulation, which incorporates both volumetric and shear strains produced by martensitic transformation, is developed. A finite element analysis is performed whereby the near-tip residual stress field is determined in notched plates of magnesia-partially stabilized zirconia subject to cyclic compression. Numerical results obtained for microcracking single phase ceramics and transformation-toughened ceramics clearly illustrate the inducement of notch-tip residual tensile stresses upon unloading from a far-field compressive stress. The residual tensile stresses, of magnitude considerably greater than the tensile strength of the solid, are created over a distance which is substantially larger than any characteristic microstructural dimension, but comparable to the experimentally-observed distance of crack growth after one compression cycle. The results obtained for ceramics are compared and contrasted with our previous studies of notch-tip residual tensile fields for metallic materials. 34 refs., 17 figs.

18645 **(DOE/ER/45302—1) Micromechanical and microstructural studies of ceramic superplasticity: Progress report, May 1, 1987-January 31, 1988.** (Michigan Univ., Ann Arbor (USA). Dept. of Materials Science and Engineering). 31 Jan 1988. Contract FG02-87ER45302. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005793/JAW.

Superplasticity of zirconia-mullito composites was studied. The strain rate of these composites decreases with the mullite fraction. Y-Ba_2Cu_3O/sub x/ was found to produce pronounced textures upon being hot pressed and extruded. 7 figs. (DLC)

18646 **(MINTEK-M—258) A market survey and alloy classification of hardfacing materials available in South Africa.** Henderson, J.L.; Dalton, J.H.; Zwirn, G.G. (ed.). (Council for Mineral Technology, Randburg (South Africa). Physical Metallurgy Div.). 28 May 1986. 25p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900339/JAW.

The nature of abrasive and impactive wear is discussed briefly, after which a description is given of various processes used for laying down of hardfacings on metals. The advantages and disadvantages of the different processes are discussed. The main part of the report consists of a classification of the consumables used in hardfacing processes. In the classification, the hardness of the deposit is considered as a function of total alloy content. This classification shows that the consumables can conveniently be divided into eight groups: five into the so-called alloy type and three into the hardfacing type, which consists of particles of the primary carbide phase dispersed in an iron-rich matrix. A brief metallurgical description is given for each group, together with typical areas of application. 10 refs., 7 figs., 14 tabs.

18647 **(N—88-11830) Friction and wear of TPS fibers. Progress Report.** Bascom, W.D.; Wong, S. (Utah Univ., Salt Lake City (USA)). Nov 1987. 14p. (NASA-CR—181496; NAS—1.26:181496). NTIS, PC A03/MF A01.

The sliding friction behavior of single filaments of SiO_2, SiC, and an aluminoborosilicate has been determined. These fibers are used in thermal protection systems (TPS) and are subject to damage during weaving and aero-maneuvering. All fibers exhibited stick-slip friction indicating the successive formation and rupture of strong junctions between the contacting filaments. The static frictional resistance of the sized SiC filament was 4X greater than for the same filament after heat cleaning. This result suggests that the sizing is an organic polymer with a high shear yield strength. Heat cleaning exposes the SiC surface and/or leaves an inorganic residue so that the adhesional contact between filaments has a low fracture energy and frictional sliding occurs by brittle fracture. The frictional resistances of the sized and heat cleaned SiO_2 and glass filaments were all comparable to that of the heat cleaned SiC. It would appear that the sizings as well as the heat cleaned surfaces of the silica and glass have low fracture energies so that the sliding resistance is determined by brittle fracture.

18648 **(NP—8751799) Evaluation of ceramic thermal barrier coatings for gas turbine engine components. Final report.** Buergel, R.; Schneider, K.; Trueck, B. (Brown Boveri Reaktor G.m.b.H., Mannheim (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Aug 1986. 53p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751799/JAW.

Thermal barrier coatings are currently used for various applications for thermal insulation purposes in combustion engines. The present investigation evaluates duplex thermal barrier systems under test conditions relevant for stationary gas turbines including thermal cycling, cyclic oxidation and hot corrosion. Attention is focussed on ZrO/sub 2/ - 7/8 wt% Y/sub 2/O/sub 3/ ceramic systems that have proven to be most durable for turbine applications. The test results reveal that thermal barrier systems are available which are sufficiently thermal cyclic resistant. Oxidation of the me-

tallic bond coat has been identified as the life-limiting process while hot corrosion is less of a problem at high temperatures (say 950degC or above). An approach to overcome early degradation of the bond coat is to apply layers with little processing defects, i.e. to replace air plasma spraying of metallic coats by vacuum chamber spraying or inert gas shroud spraying wherever it is technically feasible. The aims of the study could be fulfilled and there were no significant modifications of the initial work schedule necessary. Collaboration with the COST-partners has particularly contributed to round off the findings. With 21 refs., 5 tabs., 30 figs..

18649 **(UCRL—97813) Guidelines for estimation and characterization of the thermo-mechanical properties of new optical materials.** Marion, J. (Lawrence Livermore National Lab., CA (USA)). 18 Nov 1987. Contract W-7405-ENG-48. 8p. (CONF-871124—36). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004359/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Methods are discussed for the estimation and determination of the thermomechanical properties of new optical materials for laser and nonlinear applications. The goal is to characterize the important properties before materials synthesis, where possible, or for properties where no reliable estimation method is available, a secondary goal is to perform accurate measurements on small samples. The thermomechanical properties of primary emphasis for these applications are fracture toughness, an intrinsic measure of the strength of brittle materials, thermal conductivity, thermal expansion and the elastic constants.

18650 **Fracture toughness testing of silicon carbide.** Haggag, F.M.; Epstein, J.S.; Reuter, W.G.; Deason, V.A. pp 130-137 of Optical methods in composites; Proceedings of the SEM Fall Conference on Experimental Mechanics, Keystone, CO, Nov. 2-5, 1986. Bethel, CT; Society for Experimental Mechanics, Inc. (1986). (CONF-8611217—).

From Conference on experimental mechanics: optical methods in composites; Keystone, CO, USA (2 Nov 1986).

An investigation is described in which the stress intensity factors were measured for silicon carbide using single-edge notched and surface flaw specimens tested in three-point bending. In most of these tests, both the acoustic emission and the moire interferometry techniques provided valuable information with respect to the interaction of microcracks, damage zone propagation, and the critical stress intensity factor. Conclusions are drawn regarding the appropriate stress intensity factor and recommendations are offered for practical ranges of specimen geometry, reliable test techniques, and analytical procedures. 12 references.

18651 **(BNL—40445) Temperature and depth dependence of positron annihilation parameters in YBa_2Cu_3O/sub 7-?/ and La/sub 1.85/Sr/sub 0.15/CuO_4.** Lynn, K.G.; Usmar, S.G.; Nielsen, B.; van der Kolk, G.J.; Kanazawa, I.; Sferlazzo, P.; Moodenbaugh, A.R. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 8p. (CONF-871125—18). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88003494/JAW.

From 34. national vacuum symposium and topical conference; Anaheim, CA, USA (2 Nov 1987).

The temperature dependence of the positron annihilation parameters for YBa_2Cu_3O/sub 7-x/ x = 0.7, 0.4 and 0.0 and La/sub 1.85/Sr/0.15/CuO_4 were measured. The depth dependence of the $YBa_2Cu_3O_7$ was studied using a variable-energy positron beam showing a strong depth dependence in the Doppler line-shape extending up to an average depth of ~5.0 μm. It was found that a transition in the Doppler line-shape parameter, "S", was associated with the superconducting transition temperature (T/sub c/) in YBa_2Cu_3O/sub 7-x/ x = 0.4 and 0.0 while no transition was observed in the superconducting YBa_2Cu_3O/sub 6.3/. Positron lifetime parameters in $YBa_2Cu_3O_7$ were found to be consistent with positrons localized at open volume regions (probably unoccupied crystallographic sites) in this material with a lifetime of 210 psec at 300 K. These results indicate that the electron density at these unoccupied sites increases, using a free electron model, approximately 9% between 100 and 12 K. 15 refs., 4 figs.

18652 **(CONF-8711114—3) Copper valence via small polaron analysis in sinter-forged YBa_2Cu_3O/sub 7-y/ at 700°C.** Ahuja, Deepak; Dorris, S.E.; Su, M.Y.; Robinson, Q.; Johnson, D.L.; Mason, T.O. (Northwestern Univ., Evanston, IL (USA). Dept. of Materials Science and Engineering; Argonne National Lab., IL (USA)). 1987. Contract FG02-84ER45097. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004785/JAW.

From Symposium on high temperature superconductors; Boston, MA, USA (30 Nov 1987).

Via electrical property measurements (conductivity, thermopower) at 700°C on sinter-forged YBa_2Cu_3O/sub 7-gamma/, it was determined that conduction occurs via small polaron conduction in the tetragonal phase. From the thermopower and oxygen content the distribution of copper valence states was determined. 12 refs., 2 figs.

18653 **(DOE/ER/45170—4) Theoretical studies on the electronic structure and properties of complex ceramic crystals and glasses: Annual progress report, July 1, 1987-June 30, 1988.** Ching, Wai-Yim. (Missouri Univ., Kansas City (USA)). 6 Jan 1988. Contract FG02-84ER45170. 17p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005837/JAW.

Because of the unexpected discovery of the high T/sub c/ superconductivity in perovskite oxides about a year ago and the subsequent intensified research effort world-wide, our major effort during this period has been in the area of high T/sub c/ superconducting oxides. The major accomplishments covered in this report are: (1) Study of electronic structure and optical properties of $YBa_2Cu_3O_7$ and the formulation of an excitonic-enhancement model for high T/sub c/ superconductivity. (2) Study of ground-state properties of α-SiO_2, β-Si_3N_4 and ZrO_2 based on accurate self-consistent calculations. (3) Comparative study of electronic and magnetic properties of $Nd_2Fe_{14}B$, $Nd_2Co_{14}B$, $Y_2Fe_{14}B$ and $Y_2Co_{14}B$ crystals. (4) First-principles calculation of electronic structure and transport properties of Mg/sub x/Zn/sub 1-x/ metallic glasses. (5) Calculation of vibrational, infrared and Raman spectra of amorphous SiO_2 glass.

18654 **(DOE/ER/45261—T2) Structural disorder and transport in ternary oxides with the pyrochlore structure: Progress report, February 1, 1987-January 31, 1988.** Tuller, H.L. (Massachusetts Inst. of Tech., Cambridge (USA). Crystal Physics and Optical Electronics Lab.). 31 Jan 1988. Contract FG02-86ER45261. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005409/JAW.

Goal of this project is to predict and control the oxygen ion conductivity in compounds with the pyrochlore structure. The basic approach has been to vary the composition within the $Gd_2Ti_3O_7$-$Gd_2Zr_3O_7$ pyrochlore solid solution on and examine the consequent effects of changes in order parameter, lattice constant, and cation polarizability upon the ionic conductivity of these compounds. 3 figs.

18655 **(DOE/ER/45317—1) Investigations of surface coatings based on silicon and nitrogen: From amorphous Si to silicon nitride: Progress report, July 1, 1987-June 30, 1988.** Smith, F.W. (City Coll., New York (USA). Dept. of Physics). Jan 1988. Contract FG02-87ER45317. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88004995/JAW.

Initial results from studies of surface coatings based on silicon and nitrogen are presented. The rf deposition system has been upgraded with the installation of four separate electronic mass flow controllers. This upgrade has significantly improved our ability to prepare alloy films and multilayer films. a-Si/sub x/N/sub 1-x/:H films have been prepared from SiH_4 and NH_3. The effect of gas ratio $R = NH_3/SiH_4$ has been studied and films have been prepared in which no Si-H bonds are observed to be present via FTIR studies. We are extending our capabilities for optical constants measurements into the uv and ir regions.

18656 (INIS-mf—11630) Magnetic investigation of phase transitions for metal-hydrogen systems based on nickel by means of computer-aided data acquisition. Martin, W.E. (Muenchen Univ. (Germany, F.R.). Fakultaet fuer Physik). 12 Mar 1986. 183p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88752251/JAW.

In the present thesis the magnetic behaviour of Nickel-based metal-hydrogen systems is investigated in relation to its background in metal physics, in order to get information on the formation and the decomposition of metal-hydrogen phases. The magnetic investigations are performed at the systems Ni-Cu-H and Ni-Cr-H with Cu up to 40 at% and Cr up to 7 at%. The differential susceptibility is measured during hydration and decomposition of hydrides and the connection between magnetic moment and hydrogen concentration is discussed. (BHO).

18657 (LBL—23391) Laser-induced vaporization of uranium dioxide. Yagnik, S.K.; Olander, D.R. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 92p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88004892/JAW.

The vaporization of UO_2 is studied in an experiment utilizing a Nd-glass laser as a millisecond pulsed heat source. The target of solid is held in vacuum and can be rapidly heated to peak temperatures of 4500 K, as measured by a fast response automatic optical pyrometer. The pulse of vapor species from the laser-heated target is detected in-flight by a quadrupole mass spectrometer. This experimental technique was used in past to measure high temperature vapor pressures of nuclear fuel materials UO_2 and UC. The measured vapor pressures were found to be two orders of magnitude lower than the predictions based on thermochemical models and were also lower than other reported investigations. Purpose of the present work was to investigate this discrepancy in the vapor pressure measurement of UO_2. The experimental set-up was improved to eliminate possible sources of errors in the temperature measurement and in the transmission and collection of transient signals. The possibility of the mass spectrometer malfunction was also investigated. 26 refs., 36 figs.

18658 (PNL-SA—15183) Effects of oxygen annealing on YBa$_2$Cu$_3$O/sub 7-x/ superconductors. Weber, W.J.; Pederson, L.R.; Maupin, G.D.; LeBlanc, E.J. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 7p. (CONF-870878—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005687/JAW.

From Conference on atomic and molecular processing of electronic and ceramic materials: preparation, characterization and properties; Seattle, WA, USA (31 Aug 1987).

Samples of YBa$_2$Cu$_3$O/sub 7-x/ were prepared by solid state reaction of Y_2O_3, BaO_2, and CuO powders mixed in stoichiometric proportions. Powders reacted at 900°C to 925°C in air were pressed at 35 MPa into bars, sintered at 950°C in air for six hours, and slow-cooled at 50°C/h to room temperature. The effects of subsequent oxidation processing on superconducting properties were investigated in the study reported here. Oxidation anneals at one atmosphere pressure in flowing O_2 over the temperature range from 300 to 550°C were performed. Results indicate that oxidation at 450°C optimized the superconducting transition temperature at 90°K with a 2-degree transition width. High-pressure oxidation (2000 psi O_2) at 200°C for one week of a sample previously optimized at 450°C significantly decreased the volume fraction of superconducting material, but did not affect the transition temperature. Results based on iodometric titration measurements and thermogravimetric analysis suggest that under optimum conditions the copper valency is about 2.3 and oxygen stoichiometry is 6.94 ($x = 0.06$). 4 figs.

18659 (SAND—87-1824) Electrical properties of medium field, chem-prep varistors. Tuttle, B.A.; Voigt, J.A.; Binasiewicz, E.J.; Kimball, K.M. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 82p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88006147/JAW.

Medium field, chem-prep, ZnO varistors were synthesized and electrically tested. Eight formulations were used with three dopants: (1) Co (0, 0.25, 0.5 mol %), (2) Mn (0, 0.25, 0.5 mol %) and (3) Al (0, 125, and 150 ppM by weight). Al doping produced two dramatic effects: (1) an increase in the electric switching field by factors of 5 to 10, and (2) a significant enhancement of the high current density nonlinearity coefficient. Firing temperatures of 800, 900 and 1000°C were used to densify materials and produce varistors with electrical switching fields in the 3 to 10 kV/cm range. Current density vs electric field measurements were made from 1 $\mu A/cm^2$ to 10 A/cm^2 using dc and pulse techniques. The varistor with the largest nonlinearity coefficient over this extended current density range was fired at 1000°C and contained 0.25 Co, 0.25 Mn, 0.56 Bi (mol %) and 150 ppM Al (by weight). The nonlinearity coefficient was 14 at low current densities (0.1 mA/cm^2 to 5 mA/cm^2) and 28 for high current densities (0.1 to 10 A/cm^2). Because of the large nonlinearity coefficient, this varistor is the best candidate for Sandia applications of all varistors we synthesized. Further, the varistor had an electrical switch field of 5 kV/cm at 10 A/cm^2 and was greater than 96% of theoretical density. Low field dielectric properties and J vs. E characteristics as a function of temperature were measured for this varistor. 7 tabs.

18660 Conductivity of porous Ni/ZrO/sub 2/-Y/sub 2/O/sub 3/ cermets. Dees, D.W.; Claar, T.D.; Easler, T.E.; Fee, D.C.; Mrazek, F.C. (Chemical Technology Div. and Materials and Components Technology Div., Argonne National Lab., Argonne, IL 60439). *Journal of the Electrochemical Society;* **134**: No. 9, 2141-2146(Sep 1987).

The conductivity of porous Ni/ZrO/sub 2-/Y/sub 2/O/sub 3/ cermets at 1000°C was determined as a function of Ni content between 15 and 50 volume percent (v/o) of total solids for two different zirconia particle sizes (23 and 47 m/sup 2//g). Below Ni contents of 30 v/o, ionic conduction through the zirconia phase dominated. At 30 v/o Ni, a greater than three order of magnitude increase in the conductivity was observed, corresponding to a change in mechanism to electronic conduction through the Ni phase. The conductivity of cermets made with a Ni content greater than 30 v/o Ni was found to decrease with increasing temperature between 700° and 1000°C. While the conductivity of the cermets with the larger particle size zirconia was higher by more than a factor of four, all the samples studied had the same activation energy, 5.7 +- 0.1 kJ/mol. The increase in conductivity with zirconia particle size is attributed to improved Ni particle-to-particle contact, resulting from the Ni phase being able to cover more completely the surface of the zirconia matrix where it resides.

18661 Review and chemical thermodynamic representation of <U/sub 1-z/Ce/sub z/O/sub 2+-x/> and <U/sub 1-z/Ln/sub z/O/sub 2+-x/>; Ln = Y, La, Nd, Gd. Lindemer, T.B.; Brynestad, J. (Chemical Technology Div. and Chemistry Div., Oak Ridge National Lab., Oak Ridge, TN 37831). *Journal of the American Ceramic Society;* **69**: No. 12, 867-876(Dec 1986). Contract AC05-84OR21400.

The entire data base for the dependence of the nonstoichiometry, chi, on temperature and chemical potential of oxygen (oxygen potential) in (U/sub 1-z/Ce/sub z/O/sub 2+chi/) and (U/sub 1-z/Ln/sub z/O/sub 2+chi/) was retrieved from the literature and represented by a thermodynamic method. The method reproduces the behavior of the experimental data and also results in partial molal Gibbs free energy quantities that are useful for any thermodynamic calculation involving these nonstoichiometric phases.

18662 (AD-A—185989/1/XAB) Reaction mechanism of sulfur dioxide with single-crystal cobalt and chromium and CoCrAlY coatings. Final report, 1 October 1985-1 March 1987. Aprigliano, L.F. (David W. Taylor Research and Development Center, Bethesda, MD (USA)). Sep 1987. 139p. (DTNSRDC—87/027). NTIS, PC A07/MF A01.

3606 Other Materials

REFER ALSO TO CITATION(S) 17532, 17549, 17925, 17926, 17927, 17958, 17961, 17963, 17964, 17964, 17970, 17971, 17972, 17975, 17976, 17978, 17979, 17979, 17980, 17981, 17982, 17983, 17985, 17986, 18070, 18301, 18550, 18555, 18573, 18628, 18630, 18644, 18775, 18842, 19937, 19966, 19968, 20291, 20521

18663 (CONF-8711143—1) Photon-controlled growth of multilayered structures. Lowndes, D.H.; Geohegan, D.B.; Eres, D.; Mashburn, D.N.; Pennycook, S.J. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005061/JAW.

From Symposium on multilayers: synthesis, properties and nonelectronic applications; Boston, MA, USA (30 Nov 1987).

Pulsed ArF excimer laser (193 nm) photolysis has been used to deposit entirely amorphous and mixed amorphous/polycrystalline superlattice structures containing Si, Ge and Si_3N_4. High-resolution in-situ optical reflectivity measurements were used to monitor and/or control deposition. Transmission electron microscope cross-section views demonstrate that amorphous superlattice structures having highly reproducible layer thicknesses (from 70 to several hundred A), and sharp interlayer boundaries, can be deposited at low substrate temperatures under laser photolytic control. 4 figs.

18664 (DOE/ER/45194—03) [A carbanion approach to polyacetylene]: Technical progress report, April 1, 1987-January 31, 1988. Tolbert, L.M. (Georgia Inst. of Tech., Atlanta (USA). School of Chemistry). 1988. Contract FG05-85ER45194. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88006070/JAW.

This progress report is divided into the following sections: α,ω-diphenylpolyenyl anions, interrupted polyacetylene, n-polyacetylene by direct synthesis, substituted polyacetylenes, and heteropolymers. (DLC)

18665 (IA—1427, pp 107-110) Carbon/carbon composite materials - preparation and characterization. Dariel, M.S.; Agam, S.; Ganor, M.; Naveh, J. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18666 (IA—1427, pp 110-112) Oxidation of carbonaceous composite materials. Naveh, J.; Dariel, M.S.; Agam, S.; Edelstein, D.; Leibovits, O.; Gefen, Y. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18667 (IA—1427, pp 67) MOCVD growth of CdTe epilayers on various substrates. Oron, M.; Shtrikman, H.; Feldstein, H.; Cinader, G.; Raizman, A.; Bezerano, B. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18668 (IA—1427, pp 118-119) Development of IR gradient index lenses and windows. Bornstein, A.; Tsalch, T.; Roland, D. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18669 (LBL—24489) Effect of rigid inclusions on sintering. Rahaman, M.N.; De Jonghe, L.C. (Missouri Univ., Rolla (USA). Dept. of Ceramic Engineering; Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 12p. (CONF-8711115—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005745/JAW.

From 18. international conference on ceramic powder processing sciences; Orlando, FL, USA (1 Nov 1987).

The predictions of recent theoretical studies on the effect of inert, rigid inclusions on the sintering of ceramic powder matrices are examined and compared with experimental data. The densification of glass matrix composites with inclusion volume fractions of ≦0.15 can be adequately explained by Scherer's theory for viscous sintering with rigid inclusions. Inclusions cause a vast reduction in the densification rates of polycrystalline matrix composites even at low inclusion volume fractions. Models put forward to explain the sintering of polycrystalline matrix composites are discussed. 28 refs., 7 figs.

18670 (MLM—3476(OP)) Processing of glass to aluminum (low melting metals) seals via an injection molding technique. Kramer, D.P.; Massey, R.T.; Halcomb, D.L. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1987. Contract AC04-76DP00053. 19p. (CONF-871234—10). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004689/JAW.

From ASME winter meeting; Boston, MA, USA (13 Dec 1987).

Injection molding-sealing is an innovative processing technique useful in the fabrication of complex glass or glass-ceramic-to-metal seals which use low melting metals such as aluminum. During injection molding-sealing, molten glass, which may have a higher melting temperature than that of the metal parts, is injected under pressure into the metal parts while they are held in a mold. The process, which for the first time allows the formation of seals with metals that have a lower melting temperature than the glass, allows the fabrication of seals of complex geometry. 2 refs., 8 figs., 2 tabs.

18671 (ORNL/TM—10667) The influence of the fiber-matrix bond on the mechanical behavior of NICALON/SiC composites. Lowden, R.A.; Stinton, D.P. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006155/JAW.

The effect of thin coatings deposited on NICALON fibers prior to densification with silicon carbide by chemical vapor infiltration was investigated. The thin films were applied to alter the strength of the fiber-matrix bond and to protect the fibers during processing. An indentation method developed to measure the strength of fiber-matrix bonding and frictional stresses was investigated and compared to a simple tensile test technique. The influence of the coatings on the bond strength and mechanical behavior of the composite products was examined. 36 refs., 10 figs., 2 tabs.

18672 (SAND—87-1466C) Powder synthesis of $SrTiO_3$ boundary layer capacitor materials. Tuttle, B.A.; Voigt, J.A. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 8p. (CONF-8711115—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004800/JAW.

From 18. international conference on ceramic powder processing sciences; Orlando, FL, USA (1 Nov 1987).

Powders with controlled agglomerate structure were synthesized from a solution of strontium nitrate and titanium citrate to produce strontium titanate boundary layer capacitors (STBLCs). A unique citrate formation ultrasonically generated aerosol/freeze dry (CUGAFD) technique spatially froze chemical constituents and produced weakly agglomerated strontium titanate powders. Spherical particles, 20 to 300 microns in diameter, were generated. Controlled calcination resulted in particles that retained the spherical morphology and were comprised of 500 A strontium titanate crystallites. Strontium titanate surface boundary layer capacitors were fabricated by firing at 1450 deg C in hydrogen and reoxidizing at 1000 deg C in air. 11 refs., 4 figs.

18673 (UCRL—97894) Initial stages of silicon growth on the (100) surface of silicon by localized laser CVD. Kotecki, D.E.; Herman, I.P. (Lawrence Livermore National Lab., CA (USA); Columbia Univ., New York (USA). Dept. of Applied Physics). 18 Dec 1987. Contract W-7405-ENG-48. 8p. (CONF-8711147—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005420/JAW.

From Laser and particle-beam chemical processing for microelectronics; Boston, MA, USA (30 Nov 1987).

This paper reports initial results of an experimental study of the early stages of silicon thin film growth on well prepared (100)

c-Si surfaces by pyrolytic deposition from silane (SiH_4) during localized laser chemical vapor deposition (LLCVD). The rate of silicon thin film growth during low pressure (<10 Torr) deposition using tightly focussed laser beams (514.5 nm, ~ 2.5 μm FWHM) is characterized and is shown to be much slower than expected based on the previously measured silane decomposition rate. Hybrid-heating experiments, in which laser heating induces a slight temperature increase on a uniformly heated substrate in the presence of silane gas, shows that growth is inhibited within the laser irradiation region. This result suggests that a nonpyrolytic mechanism contributes to silicon growth in laser CVD. Possible explanations for this nonpyrolytic growth mechanism are discussed. 8 refs., 4 figs.

18674 **The role of low-energy ion/surface interactions during crystal growth from the vapor phase.** Greene, J.E.; Rockett, A.; Sundgren, J.E. (Materials Science Dept., The Coordinated Science Lab., and the Materials Research Lab., Univ. of Illinois, Urbana, IL 61801). pp 59-74 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Low-energy (often < 100 eV) ion bombardment during thin film deposition is commonly used in such diverse application areas as microelectronics, optical coatings, magnetic recording layers, and hard wear resistant coatings to modify the microstructure and microchemistry of films deposited by a variety of techniques (e.g. sputtering, primary ion deposition, plasma-assisted CVD, and accelerated-beam MBE). Ion irradiation has been shown to affect every phase of deposition including nucleation and growth kinetics, crystal structure and phase stability, the average grain size and degree of preferred orientation of polycrystalline films, the epitaxial temperature of single-crystal films, defect concentrations, elemental incorporation probabilities, surface segregation, and, hence, film properties. As discussed in this brief review, a detailed understanding of many of these processes is beginning to emerge. Effects such as trapping, preferential sputtering, enhanced diffusion, and collisional mixing have been used to interpret and, in some cases, model experimental results. Nevertheless, there are still large gaps in our knowledge of the role of ion bombardment on fundamental processes such as nucleation kinetics.

18675 **Surface alloys of icosahedral AlMnSi with phason distortions.** Follstaedt, D.M.; Knapp, J.A. (Sandia National Labs., Div. 1112, Albuquerque, NM 87185-5800). pp 333-338 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The microstructures produced by electron-beam melting and by ion-beam mixing Al/Mna and Al/Mn/Si layers on Si substrates are examined. The treatments were found to incorporate Si from the substrate into the surface alloy. Several phases formed, depending on treatment, including α- and β-AlMnSi, μ-AlMn (epitaxial on Si(lll), and amorphous and icosahedral AlMnSi. The observed microstructures relate the novel icosahedral phase to other phases and elucidate its formation kinetics. Diffraction patterns from large icosahedral grains (up to 5 μm) show distortions in the position and shape of weak (but not strong) reflections, as predicted for phason defects in a quasicrystalline lattice, one of the structures proposed for icosahedral phases.

18676 **Effectiveness of thin film encapsulants for reducing evaporation during rapid thermal processing of GaAs.** Haynes, T.E.; Picraux, S.T.; Chu, W.K. (Dept. of Physics and Astronomy, Univ. of North Carolina, Chapel Hill, NC 27514). pp 693-698 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

A technique is described for direct measurement of evaporation of Ga and As from capped GaAs during RTP. Application of this method to the study of Si, SiO/sub 2/, and Si/sub 3/N/sub 4/ caps with thicknesses of 20 nm to 60 nm provides a direct measure of the temperature ranges for which the caps are able to prevent evaporation during RTP. In addition, kinetic studies of the evaporation at slightly higher temperatures provides information useful for establishing the predominant evaporation mechanism. For the encapsulants studied, these measurements indicate that the observed evaporation is due to formation of cracks in the film during the initial 10 sec of RTP.

18677 **Fabrication of polycrystalline thin film of CuInSe/sub 2/ by a one-step electrodeposition process.** Pern, E.J.; Noufi, R.; Mason, A.; Swartzlander, A. (Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO 80401). pp 1295-1298 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—). Contract AC02-83CH10093.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

A simple one-step electrodeposition process was demonstrated to produce device quality CuInSe/sub 2/ thin films from acidic aqueous solutions. The electrodeposited thin films showed compositional uniformity, smooth surface, and good adhesion. After annealing, the films are shown to possess chalcopyrite structure and exhibit photovoltaic activity when made into devices with CdS top layer.

18678 **(BNL—40658) Glancing angle EXAFS studies of tungsten-carbon multilayers.** Lamble, G.M.; Heald, S.M.; Sayers, D.E.; Ziegler, E. (Brookhaven National Lab., Upton, NY (USA); Argonne National Lab., IL (USA); North Carolina State Univ., Raleigh (USA)). 1987. Contract AC02-76CH00016. 8p. (CONF-871124—68). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005603/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Results are presented from glancing angle EXAFS studies of three tungsten-carbon multilayer systems, of different W/C thickness ratios, by monitoring the fine structure above the tungsten L3-edge. The purpose of the investigations was to determine the structural changes occurring in the multilayer as a result of moderate annealing. Surprisingly, dramatic changes are observed in the structural environment of the W atoms as a result of heating to temperatures as low as 350°C for 3 hours. It is found that, when the W layer is sufficiently thick, and the W/C layer thickness favorable, W_2C is preferentially formed and crystallization is extensive. The experiment demonstrates the suitability of the EXAFS technique for the study of multilayer systems since, (1) contribution to the signal from the interface is significant and (2) the phenomenon is not dependent on the existence of long-range order. 6 figs.

18679 **(CONF-871124—62) X-ray diffraction study of a thin GaAs film on Si(100).** Bommannavar, A.S.; Sparks, C.J.; Habenschuss, A.; Ice, G.E.; Dhere, A.; Morkoc, H.; Zabel, H. (Oak Ridge National Lab., TN (USA); Illinois Univ., Urbana (USA)). 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005290/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

A 900 A single crystalline GaAs film deposited by molecular beam epitaxy (MBE) on a silicon crystal cut 4.1° from (001) surface was characterized with x-ray diffraction measurements of the mosaic spread, particle size and strain distribution, and lattice parameter. The GaAs film had a larger mosaic spread in the direction of the steps of the silicon surface and coherent particle sizes of about 900 A compared to the estimated film thickness of approximately 1000 A. Superlattice reflections gave an ordered domain size of about 330 A. There is a residual strain gradient in the film which is nearly linear with the lattice constant differing by about 0.044 A between the surface of the film and its interface with the silicon substrate. Lattice parameter measurements indicate a small expansion of 0.13% perpendicular to the plane of the film. 6 refs., 4 figs., 2 tabs.

18680 **(CONF-871124—75) Structural studies of pillared clays and modified pillared clays.** Carrado, K.A.; Thompson, A.R.; Winans, R.E.; Botto, R.E. (Argonne National Lab., IL (USA)). Nov 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005954/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The long-range order of pillared interlayered clays (PILCs) after acid activation with 0.05N HCl has been investigated by X-ray diffraction (XRD) methods. The data show that long-range order in PILCs decreases as AlCH-PB = ZrCH-PB much greater than Zr/AlCH-PB = Cr/AlCH-PB (PB = pillared bentonite; MCH = metal chlorohydroxy pillaring agent, where M = Al, Zr or Cr). Apparently, pure oxide clusters are more stable than mixed oxide clusters. Treatment of PILCs with dilute HCl at 25°C is less damaging than at reflux temperature, and calcined PILCs are more stable than air-dried materials. More structural damage occurs with 3M sulfuric acid treatment than with dilute HCl. Treatment with a weak base also causes some degradation of the pillars. ^{27}Al-MAS NMR has been used to study pillared hectorite (PH), as well as other clay systems. The large increase of the observable octahedral aluminum (Al(VI)) resonance seen after pillaring is explained by loss of water from the $[Al_{13}O_4(OH)_{24}(H_2O)_{12}]^{7+}$ (Al_{13}) cation. ^{27}Al spectra of PILCs derived from different pillaring agents and exposed to various heat and acid treatments are remarkably similar. 16 refs., 1 fig., 1 tab.

18681 (IA—1427, pp 100) **Distribution coefficient of rare-earth ions in YAG crystals.** Shimony, Y.; Goldbart, Z. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18682 **(LBL—24116) Preparation of zeolites for TEM [Transmission Electron Microscopy] using microtomy.** Csencsits, R.; Gronsky, R. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 8p. (CONF-871124—71). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005747/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The application of microtomy to Transmission Electron Microscopy (TEM) specimen preparation of zeolite catalysts is explained. Using a new acrylic resin (LR White) thin sections (≦60 nm) may be cut with relative ease. Although the details described are specific to catalysts, microtomy and the use of the acrylic resin are applicable to any hard ceramic powder sample. 3 figs.

18683 **(LBL—24117) Electron microscopy study of morphology and composition of a ferrisilicate catalyst.** Csencsits, R.; Gronsky, R.; Nair, V.; Szostak, R. (Lawrence Berkeley Lab., CA (USA); Union Carbide Corp., Tarrytown, NY (USA); Georgia Inst. of Tech., Atlanta (USA). Research Inst.). Dec 1987. Contract AC03-76SF00098. 8p. (CONF-871124—70). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005754/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The effects of various synthesis conditions on the structure and composition of ferrisilicate analogs of zeolite ZSM-5 were considered. Scanning electron microscopy (SEM) was used to determine the particles size distributions and morphologies. Particle sizes vary from tenths of a micron to several microns, depending on degree of agitation during crystal growth, while morphology is additionally dependent on the concentration of iron in the gel during crystallization. X-ray emissive spectroscopy (XES) performed in the transmission electron microscope (TEM) was used to determine their composition variation. The distribution of iron among the crystals is more homogeneous if the gel is stirred and it does not depend on particle size. 3 figs., 1 tab.

18684 **(LBL—24376) The effect of alkali metal cations on the structure of dissolved precursors to zeolites.** McCormick, A.V.; Bell, A.T.; Radke, C.J. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 7p. (CONF-871124—65). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005448/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

By means of ^{29}Si NMR spectroscopy, it is established that the distribution of silicate anions in alkaline silicate solutions is a moderate function of base composition. At a fixed SiO_2 concentration and silicate ratio, the proportion of Si present in oligomeric and cage-like structures increases in progressing from Li to Cs hydroxide. Interactions between alkali metal cations and silicate anions are investigated using NMR spectroscopy of the cations; in this way the concentration of ion pairs is measured as a function of cation size. As a result the silicate redistribution is ascribed to cation-silicate anion pairing and to a higher selectivity for ion pairing by large silicate anions as cation size increases. 19 refs., 4 figs.

18685 **(LBL—24523) Lattice relaxation of the DX centers in Ga/sub 1-x/Al/sub x/As and of the pressure-induced deep donors in GaAs.** Li, M.F.; Shan, W.; Yu, P.Y.; Hansen, W.L.; Weber, E.R.; Bauser, E. (Lawrence Berkeley Lab., CA (USA); Max-Planck-Institut fuer Festkoerperforschung, Stuttgart (Germany, F.R.)). Nov 1987. Contract AC03-76SF00098. 7p. (CONF-871124—66). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005452/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Deep Level Transient Spectroscopies (DLTS) and capacitance transient techniques have been applied to GaAs:Si and to Ga/sub 1-x/Al/sub x/As:Te (x = 0.35) under quasi-hydrostatic pressure using a diamond anvil cell. By substituting the experimental pressure coefficients of the defect energies into a model proposed by Li and Yu (Solid State Commun. 61, 13 (1987)) we concluded that both the DX center in the GaAlAs alloy and the pressure-induced deep donor (PIDD) in GaAs have large lattice relaxations associated with them.

18686 **(MHSMP—87-54) Size exclusion chromatography (XIII): Identification and quantitation of silicon hydride containing oligomeric components of Sylgard prepolymers.** Kohn, E.; Chisum, M.E.; Moore, K.L. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Dec 1987. Contract AC04-76DP00487. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004234/JAW.

Methods for the identification and quantitation of oligomeric, silicon hydride (SiH), containing components of Sylgard prepolymers (polydimethylsiloxane: PDMS) have been developed. They employ a combination of size exclusion chromatography (SEC), with infrared (ir) and differential refractometer (DR) detection and gas chromatography/mass spectrometry (GC/MS) verification. The identified oligomers were present at about 20% of total prepolymer and contained from one to six SiH linkages per molecule. Such lower molecular weight oligomers may contribute to the vapor pressure of resins prepared from the prepolymers since they may contain a significant number of molecules which have only one or two SiH groups and are not capable of forming large polymeric structures. 5 refs., 8 figs., 2 tabs.

18687 **(SAND—87-1422C) Porosity determinations in buried and surface layers of porous silicon.** Guilinger, T.R.; Kelly, M.J.; Tsao, S.S. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 8p. (CONF-871124—37). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003636/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Gravimetric techniques offer a convenient and accurate method of determining surface layer porosity in both n- and p-type porous silicon (PS). Porosity of the PS affects its volume expansion on oxidation and the insulating properties of the resulting oxide. Optimal porosity (ca. 55%) yields fully dense, insulating oxides with minimal expansion-induced stresses. Two factors affect the porosity: chemical dissolution of PS by the anodization electrolyte,

and oxidation of the PS to produce a native oxide on the surface. Buried layer porosities cannot normally be measured by gravimetric techniques unless the volume of the buried layer is large enough to yield a measurable weight change on anodization. We therefore used a form of Faraday's Law to determine buried layer porosities and determined that they can be correlated with porosities of surface layers formed under identical conditions. 9 refs., 4 figs.

18688 **(SAND—87-1514C) Interface velocity transients during melting of a-Si/c-Si thin films.** Tsao, J.Y.; Aziz, M.J.; Peercy, P.S.; Thompson, M.O. (Sandia National Labs., Albuquerque, NM (USA); Harvard Univ., Cambridge, MA (USA); Cornell Univ., Ithaca, NY (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-871124—34). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003937/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

We report transient conductance measurements of liquid/solid interface velocities during pulsed laser melting of amorphous Si (a-Si) films on crystalline Si (c-Si), and a more accurate, systematic procedure for analyzing these measurements than described in previous work. From these analyses are extracted relations between the melting velocities of a-Si and c-Si at a given interface temperature, and between the temperature during steady-state melting of a-Si and c-Si at a given interface velocity. 14 refs., 3 figs.

18689 **(SAND—87-1531C) Effects of carbon concentration upon oxygen precipitation in Cz Si.** Hahn, S.; Arst, M.; Ritz, K.N.; Shatas, S.; Stein, H.J.; Rek, Z.U.; Tiller, W.A. (Siltec Silicon, Menlo Park, CA (USA); Signetics Corp., Sunnyvale, CA (USA); Nanosil, Santa Clara, CA (USA); Sandia National Labs., Albuquerque, NM (USA); Stanford Univ., CA (USA)). 1987. Contract AC04-76DP00789. 5p. (CONF-871124—43). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003307/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Effects of high carbon concentration upon oxygen precipitate formation in Cz silicon have been investigated by combining various furnace and rapid thermal anneals. Even though oxide precipitate density increases with increasing carbon levels, C/sub s/, synchrotron radiation section topographs of processed high carbon content wafers (C/sub s/ ~4ppMa) exhibit Pendellosung fringes, indicating a strain free bulk state. Our optical microscopic data have also shown very few defect etch features inside the bulk. A model based upon a direct coupling of both SiO_2 and Si-C complex formation reactions is used to explain rather unique oxygen precipitation characteristics in the high carbon content Cz Si materials. 5 refs., 1 fig., 1 tab.

18690 **(SAND—87-1600C) Breathing mode lattice relaxation associated with carrier emission and capture by deep electronic levels in silicon.** Samara, G.A. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-871124—28). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88003844/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The breathing mode (volume) lattice relaxations associated with carrier emission and capture are evaluated for a variety of deep levels in silicon using a recently proposed method based on high pressure measurement of the emission rates and capture cross sections. Included are (1) the vacancy-like acceptor levels associated with the oxygen-vacancy pair (or A-center) and the gold, platinum and palladium impurities, (2) the chalcogenide donors in their singly- and doubly-charged states and (3) a number of 3d transition metal donors. The signs and magnitudes (which range from ~0 to $5A^3$/emitted carrier) of these relaxations are discussed in terms of models for the impurities and defects responsible for the associated levels. The results on the chalcogenides are compared with recent theoretical calculations. 8 refs., 1 tab.

18691 **(SAND—87-2333C) Integral equation theory of homopolymer melts.** Curro, J.G.; Schweizer, K.S. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 25p. (CONF-871190—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005304/JAW.

From Workshop on neutron scattering; Los Alamos, NM, USA (3 Nov 1987).

A general theory is developed for the equilibrium structure of dense polymer melts. This theory is based on an integral equation approach developed by Chandler and coworkers for molecular liquids. We are able to construct a tractable formalism for the polymer problem by employing the fact that a polymer molecule in a melt is ideal. This leads to a set of integral equations for the intermolecular radial distribution functions. In the case of a long linear chain this set approximately reduces to a single integral equation which we have solved numerically for the case of Gaussian and freely-jointed chain intramolecular statistics with repeat units interacting via hard core repulsions. From this solution we obtained the radial distribution function, structure factor, and compressibility as functions of liquid density and degree of polymerization. Unlike the random phase approximation (RPA) approach of deGennes, the present theory allows for density fluctuations. These density fluctuations, which decay on a length scale comparable to a few monomer units, are crucial for the calculation of the structure factor and thermodynamic properties such as the equation-of-state of the polymer fluid. Generalizations of the present theory to include chain stiffness effects and attractive interactions are possible.

18692 **(SAND—87-2334C) Integral equation theory of polymer blends.** Schweizer, K.S.; Curro, J.G. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 18p. (CONF-871190—2). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005305/JAW.

From Workshop on neutron scattering; Los Alamos, NM, USA (3 Nov 1987).

An off-lattice microscopic statistical mechanical theory of the equilibrium properties of polymer mixtures is developed based on modern integral equation methods. A rigorous derivation of the RPA scattering function is presented along with a fully microscopic, exact formula for the effective chi-parameter measured in SANS experiments. Numerical results for a hard core Gaussian polymer binary blend are presented. Chi is found to be a sensitive function of concentration, packing fraction, molecular weight, and structural asymmetry.

18693 **Dynamics of rapid solidification in silicon.** Peercy, P.S.; Thompson, M.O.; Tsao, J.Y. (Sandia National Labs., Albuquerque, NM 87185). pp 15-30 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—). Contract AC04-76DP00789.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Real-time techniques were used to study rapid melt and solidification dynamics in silicon. In crystalline Si, the interface response function was characterized and found to be asymmetric for large deviations from the melting temperature, which will require reevaluation of conventional transition state treatments of melt and solidification. In amorphous Si, the mechanism of explosive crystallization was studied. The explosive transformation is mediated by a buried liquid layer, and detailed measurements have led to the suggestion that polycrystalline Si nucleates at the moving liquid-amorphous interface. For certain conditions, this process could yield fine-grained polycrystalline Si; for other conditions it permits epitaxial regrowth from the underlying crystalline Si for maximum melt thickness much less than the original amorphous layer thickness.

18694 **Transition-state model for entropy-limited freezing.** Tsao, J.Y.; Aziz, M.J.; Peercy, P.S.; Thompson, M.O. (Device Research Dept., Sandia National Labs., Albuquerque, NM 87185). pp 117-122 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

A brief review is given of transition-state theory, both for the case of unimolecular reactions in the gas phase, and for reactions in condensed phases. An argument is made that, within the context of this theory, heterogeneous freezing in Si is limited to rates much lower than collision rates by the difference between the entropies of the solid and the liquid.

18695 **Analysis of picosecond pulsed laser melted graphite.** Steinbeck, J.; Braunstein, G.; Speck, J.S.; Dresselhaus, M.S.; Huang, C.Y.; Malvezzi, A.M.; Bloembergen, N. (Massachusetts Institute of Technology, Cambridge, MA 02139). pp 263-268 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

A Raman microprobe and TEM have been used to analyze the resolidified region of liquid carbon generated by picosecond pulse laser radiation. From the relative intensities of the zone center Raman-allowed mode for graphite at 1582cm/sup -1/ and the disorder-induced mode at 1360cm/sup -1/, the average graphite crystallite size in the resolidified region is determined as a function of incident pulse energy density. By comparing with Rutherford backscattering spectra and Raman spectra from nanosecond pulsed laser melting experiments, additional information about the disorder depth in picosecond pulsed laser melted graphite is obtained. Comparisons of TEM micrographs for nanosecond and picosecond pulsed laser melting experiments show that the structure of the laser disordered regions in graphite are similar and exhibit similar behavior with increasing laser pulse fluence. The similarities in the resolidified regions under both irradiation schemes discourages a determination of the properties of liquid carbon after the liquid has resolidified.

18696 **Atomic beam interactions with silicon (111) surfaces: A molecular dynamics study.** Dodson, B.W.; Taylor, P.A. (Sandia National Labs., Albuquerque, NM 87185). pp 463-470 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—). Contract AC04-76DP00789.

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

Low energy (5-20 eV) atomic beam-surface interactions have been studied using a molecular dynamics technique. Silicon atoms are directed at an unreconstructed (111) silicon substrate either perpendicular to the surface or at grazing angles of incidence from 10-35°. The Si-Si interaction is treated using an empirical many-body silicon potential so that the effects of covalent bonding are included. At general beam orientations relative to the surface, low energy atoms are rapidly adsorbed at the surface, whereas at higher energies they either bounce off the surface or penetrate into the substrate. However, when the surface component of beam momentum is parallel to a (100) symmetry direction, Si atoms, under certain conditions, are found to channel along the surface rows, resulting in very little local excitation of the surface geometry and only gradual energy loss. The vertical momentum is carried away by substrate lattice vibrations, and the particle is guided along the surface by interaction with the atoms making up the surface 'half-channels'. This surface channeling effect offers considerable promise for delicate control of the beam-induced annealing/growth of non-equilibrium surface geometries, and thus for high-quality growth at low temperatures.

18697 **(UCRL-Trans—12199) Characterization of surfaces by grazing reflection of x-rays: Application to investigation of polishing of some silicate glasses.** Nevot, L.; Croce, P. Translated from *Revue de Physique Appliquee ;* **15**: 761-779(1980). Contract W-7405-ENG-48. 52p. (In English). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88001638/JAW.

A theory is elaborated in order to explain the effects of surface roughness and locally varying bulk dielectric constant n/sup 2/ (due to changes either in composition or in compaction of the material) upon grazing x-ray reflection. An explicit formulation is derived assuming that surface heights have a gaussian distribution and n/sup 2/ is only related to depth as measured from the mean plane of the irradiated surface. Analysis of silicate glasses mechanically polished on a pitch tool, with various oxides suspended in water, shows that the polish layer always consists in two well separated zones. The first one is the outer layer, non exceeding a few nanometers in thickness, has a density lower than of the bulk and might be due to both plastic creeping and hydrolysis during the polishing process. The second is the underlying layer which extends up to tens of nanometers and results either from a densification process, as in pure silica or alumino silicate glasses, or from a depletion process as in high alkaline silicate glasses. The effects of time in polishing and of the oxides used as well as later heat treatments are examined in correlation with the parameters characterizing both layers. 25 refs., 9 figs., 1 tab.

18698 **(BNL—40419) The effect of $Ca(OH)_2$-treated ceramic microspheres on the mechanical properties of high-temperature lightweight cement composites.** Sugama, Toshifumi. (Brookhaven National Lab., Upton, NY (USA)). Oct 1987. Contract AC02-76CH00016. 11p. (CONF-871250—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004590/JAW.

From Symposium on interfaces in cementitious composites; Boston, MA, USA (2 Dec 1987).

The compressive strength and water permeability of high-temperature lightweight cementing materials containing sillimanite-based hollow microspheres as a filler can be improved by treating the surfaces of the microspheres with a $Ca(OH)_2$-saturated solution at temperatures up to 200°C. The precipitation of an epitaxial layer formed by an interaction between a hot calcium hydroxide solution and the surface of the sphere plays an essential role in developing favorable bonding characteristics at the interfaces and in promoting the hydration of the cement matrix. It was observed that tobermorite-truscottite transformation and anorthite formation during autoclave exposure for 180 days in brine at 300°C results in slight strength reductions and increased water permeability. 7 refs., 2 figs., 3 tabs.

18699 **(DOE/ER/45238—T2) [Properties of molecular solids and fluids at high pressure and temperature]: Annual report.** Etters, R.D. (Colorado State Univ., Fort Collins (USA). Dept. of Physics). 1987. Contract FG02-86ER45238. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004195/JAW.

Equilibrium structures, orientations, and magnetic order, lattice librational and vibrational mode frequencies, intramolecular vibron mode frequencies, sound velocities, equations of state, compressibilities, thermal expansion coefficients, and phase transitions in molecular solids over a wide range of temperatures and were pressures were determined. Except for structures and orientations, which are not static, similar properties were calculated in the fluid, in addition to virial coefficients, viscosities, specific heats, and dyamic correlations of positions, orientation, and local magnetic order. Techniques used include several strategies to optimize multidimensional functions as a means to determine structures and orientations, as does constant pressure and constant volume. Monte Carlo methods which also yields thermodynamic quantities and is a powerful method for characterizing phase transitions. Lattice dynamics, mean field methods, and classical perturbation theory are some of the analytic tools we use to determine dynamical features. Systems studied include H_2, N_2, O_2, CO, CO_2, F_2, I_2, N_2O, Cl_2, Br_2, HCl, HBr, and HI. 30 refs.

18700 (DOE/PC/91024—T4) Characterization and fundamental studies on CuO sorbent materials to determine attrition mechanisms on substrate gamma alumina: Technical progress report No. 3 for the period March 23 to June 23, 1987. Mote, J.D.; Eucker, P.; Zhu, Zuming. (Denver Univ., CO (USA). Dept. of Engineering). 1987. Contract AC22-86PC91024. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003674/JAW.

More detailed analysis of the impact properties of the sorbent materials in their various states were conducted during this quarter. Particle size determinations of sorbent spheres in various states were made by x-ray line broadening measurements. The materials examined indicate an increase in the particle size after sorption-desorption in the pilot facility. The possible effect of an increase in particle size on the mechanical properties is discussed. 2 refs., 2 tabs.

18701 (IA—1427, pp 61) Photoelectromagnetic effect in p-type Hg/sub 1-x/Cd/sub x/Te liquid phase epitaxial layers. Mordowicz, D.; Zemel, A.; Eger, D. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18702 (IA—1427, pp 95-96) Low temperature elastic properties of the permanent magnet compound Nd/sub 2/Fe/sub 14/B. Dadon, D.; Dariel, M.P.; Gefen, Y.; Klimker, H.; Rosen, M. (Israel Atomic Energy Commission, Tel Aviv; Johns Hopkins Univ., Baltimore, MD, USA). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18703 (IA—1427, pp 116) Improved p-type thermoelectric material. Ilzycer, D.; Yellin, N.; Sinvani, M.; Shilon, M. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18704 (MLM—3477(OP)) Stress analysis of header material sets. Woods, C.M.; Merten, C.W. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1987. Contract AC04-76DP00053. 7p. (CONF-871234—9). NTIS, PC A02. Order Number DE88004690/JAW.

From ASME winter meeting; Boston, MA, USA (13 Dec 1987).

Header design ideology and material selection are described. Current header designs utilize a glass-ceramic insulator which is bonded to a current carrying pin and a metal shell. Residual stresses in the header occur as a result of cooling from the glass softening temperature and are attributable to differences within the header material set in coefficients of thermal expansion. A stress analysis is undertaken to model the residual thermal stresses in glass-ceramic headers. A feature of this model is that it simulates bonding at glass-ceramic to metal interfaces by precluding interfacial sliding. Residual stresses for four material sets are analyzed. These material sets are chosen to illustrate the various stress states which can arise due to differing combinations of coefficients of thermal expansion within a material set. 9 refs., 10 figs., 2 tabs.

18705 (MLM—3478(OP)) Improved glass-ceramic to metal seals in actuator and detonator applications with an aluminum-containing austenitic stainless steel. Birkbeck, J.C.; Cassidy, R.T.; Fagin, P.N.; Moddeman, W.E. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 1987. Contract AC04-76DP00053. 11p. (CONF-871234—8). NTIS, PC A03. Order Number DE88004691/JAW.

From ASME winter meeting; Boston, MA, USA (13 Dec 1987).

Requirements for the formation of a strong, hermetic seal between a glass-ceramic and a metal, in actuator and detonator applications, were reviewed. The necessary parameters are: (1) a high strength metal; (2) a match in the thermal expansion coefficient between the metal and glass-ceramic; (3) wettability of the metal by the glass; and (4) the chemical compatibility at the glass-ceramic/metal interface at sealing temperatures. An Al_2O_3 layer, acting as a buffer between the glass and the metal, should be included to protect the metal from the glass attack. A model was proposed and tested with an aluminum-containing alloy (899) which formed a tightly adhering Al_2O_3 layer when pre-sealed heated in air. This Al_2O_3 layer was verified by Auger electron spectroscopy and is wettable by the glass and chemically compatible with it, as seen in the optical photomicrographs. The coefficients of thermal expansion for the oxide layer and the alumina-rich glass/oxide boundary were found to be acceptable. 23 refs., 7 figs.

18706 (PB—88-128236/XAB) Results from the melting of tungsten composites under microgravity (Texus 10 flight). Ekbom, L. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Sep 1987. 18p. (In Swedish). (FOA-C—20676-2.1). NTIS, PC E03/MF A01.

A preliminary melting test with tungsten composites on a Texus 10 flight was done. The melting test shows that the system is of interest for further investigations. The heavy tungsten particles floating in a matrix melt of nickel-iron grew very rapidly. They had an even distribution in the matrix after solidification.

18707 (PD-MT—8721) Studies on some Ge-Se-Te glasses. Mahadevan, S.; Giridhar, A.; Singh, A.K. (National Aeronautical Lab., Bangalore (India)). Jun 1987. 52p. NTIS, PC A04/MF A01.

Results of measurements of the glass transition temperature (T sub g), electrical conductivity (sigma) and density (d) are reported for eight glass compositions of the Ge-Se-Te system. For $(GeSe_2)(100-2x)Se(x)Te(x)$ glasses, a monotonic increase of sigma and d with increase in Te content is seen. The T sub g of these glasses shows a decrease with increaseing Te content. For the $(GeSe_2)23.33Se(30-x)Te(x)$ glasses, the T sub g does not vary with composition because the effective connectedness remains the same. Sigma and delta E show a smooth variation across the tie line composition Ge23.33Se61.67Te15 prime while a kink is seen at this composition for density and molar volume. The composition Ge23.33Se51.67Te25 is found to exhibit microphase separation and reigsters double T sub g and double T sub C. The compositions of the two phases are found to be approximately Ge25Se62.5Te12.5 (residual glass) and approximately Ge22.5Se46.3Te31.2 in the approximate weight ratio of 1:2. On partial crystallization the sigma and d of this glass are found to decrease before they register an increase on complete crystallization of the glass. A model where Te crystallizes out from the first glassy phase and is found to be dispersed discontinuously in a semiconducting glassy matrix consisting of essentially $GeSe_2$ and the residual glass is found to account for the variations of sigma and the density during crystallization of this composition. On complete crystallization, when $GeSe_2$, GeTe and additional Te are all crystallized, an increase in density and a steep increase of sigma are seen.

18708 (PD-MT—8722) Thermal expansion of some Ge-Se-Te glasses. Mahadevan, S.; Giridhar, A.; Singh, A.K. (National Aeronautical Lab., Bangalore (India)). Jul 1987. 22p. NTIS, PC A03/MF A01.

Results of the measurement of thermal expansion coefficient (from 50 C to the softening temperature) are reported for eight glass compositions of the Ge-Se-Te system. For the $(GeSe_2)$ sub 100-2x Se sub 30-x Te sub x glasses, an increase of T sub g and of Delta alpha is seen with decreasing SeTe content. For $(GeSe_2)$ sub 23.33 Se sub 30-x Te sub x glasses, alpha, T sub g, and Delta alpha are invariant with composition. The results obtained, when examined along with those obtained for other chalcogenide glasses, show that chalcogenide glasses are not necessarily in a state of isofree volume during glass transition. Values ranging from 0.024 to 0.167 are obtained for the free volume of some chalcogenide glasses.

18709 (PNL-SA—15269) Interfacial chemistry-structure and fracture of ceramic composites. Jones, R.H.; Henager, C.H. Jr.; Schilling, C.H.; Schoenlein, L.H.; Weber, W.J. (Pacific Northwest Lab., Richland, WA (USA); Los Alamos National Lab., NM (USA)). Jan 1988. Contract AC06-76RL01830. 13p. (CONF-880118—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005516/JAW.

From Conference on composite materials and structures; Cocoa Beach, FL, USA (20 Jan 1988).

The interfacial chemistry and structure of SiC/Si_3N_4 composites has been evaluated using TEM/STEM and AES. Nicalon SiC fiber reinforced hot-pressed Si_3N_4 and VLS single crystal SiC reinforced reaction-bonded silicon nitride (RBSN) have been evaluated. An amorphous carbon-graphite interface structure was observed in the Nicalon SiC fiber-reinforced material resulting from sizing used to assist fiber handling. Fiber pull-out occurred upon fracture of the composite material with the fracture apparently occurring between the amorphous and graphitic carbon layers. The flexure strength of the composite was about 1/3 that of the matrix with the degradation apparently resulting from the development of a glass phase in the grain boundaries of the Nicalon during hot pressing. The interfaces of Si_3N_4 matrix composites with C, BN, SiO_2 coated and untreated VLS whiskers were found to vary markedly. In the RBSN composites, the C was present in the form of a fibrous graphitic structure, the BN coating was nonexistent but large facets had formed on the whiskers while the SiO_2 coating was present as a discontinuous glass phase. The composite with the SiO_2 coated whiskers exhibited the highest fracture strength and toughness while the material made with BN-coated whiskers exhibited the lowest values. 4 figs., 1 tab.

18710 (SAND—87-1591C) Pressure-dependent DLTS [Deep Level Transient Spectroscopy] experiments on Si-doped AlGaAs. Farmer, J.W.; Hjalmarson, H.P.; Samara, G.A. (Missouri Univ., Columbia (USA). Research Reactor Facility; Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 9p. (CONF-871124—27). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88003842/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Pressure dependent Deep Level Transient Spectroscopy (DLTS) experiments are used to measure the properties of the deep donors (DX-centers) responsible for the persistent photoconductivity effect in Si-doped AlGaAs. The sample dependence of the DLTS spectra shows evidence for a defect complex involved in the DX-center. 9 refs., 4 figs.

18711 (SAND—87-1592C) Energy loss rates for light holes in InGaAs/GaAs strained layer single quantum wells. Smith, M.C.; Jones, E.D.; Fritz, I.J.; Drummond, T.J.; Zipperian, T.E.; Schirber, J.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 6p. (CONF-871124—72). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005744/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Energy relaxation rates for light holes in InGaAs/GaAs strained layer quantum wells are measured. Two techniques were used to measure light hole temperatures as a function of power dissipated in the hole gas. For T/sub h/ $<$ 20K, Shubnikov-de Haas oscillations were used and for T/sub h/ $>$ 20K, a photoluminescence technique was employed. 4 figs., 1 tab.

18712 (SAND—87-1884) Interface structure and properties of alumina/glass ceramic composites. Keddie, J.L.; Michalske, T.A. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006219/JAW.

Tough fiber-reinforced composites depend on fiber pull-out and crack bridging to arrest cracks in the matrix. In order to achieve fiber pull-out, there must be a weak interface between the matrix and the fiber. In this study, the interface formed at elevated temperatures between alumina and a zirconia-bearing glass-ceramic was characterized to determine its chemical and mechanical properties. The interface was analyzed in planar and cross-sectional specimens by SEM, TEM, optical microscopy, and x-ray diffraction. It was found that the diffusion of alumina into the glass-ceramic produces a dense layer of zirconia crystallization in the glass-ceramic within 20 microns of the alumina. The strength of the interface is inversely proportional to the thickness of this layer. Firing at longer times and higher temperatures produces the weakest interface. Activation energies (Q) and diffusion coefficients of aluminum into the glass matrix were calculated using a nonlinear regression analysis and data from ion microprobe profiles. Q was calculated to be 538 kJ/mol and the preexponential diffusion coefficient, D_0, was found to be 4.96 x 10^7 cm^2/s. Some interfaces fractured spontaneously, possibly because of the martensitic transformation of zirconia. Although it is possible to achieve a weak interface, a weak interface demands long firing times (greater than three hours) or high temperatures (greater than 1425°C). Under such rigorous conditions, a 20 μm diameter alumina fiber will totally dissolve. For this reason, the development of an in-situ ZrO_2 crystallization layer is not a suitable method to produce tough alumina fiber reinforced/glass ceramic composites. 18 figs., 4 tabs.

18713 (SAND—87-2590C) Electrical characteristics of MBE [molecular beam epitaxy]-grown GaAs/sub 1-x/Sb/sub x/ on InP and correlation with film microstructure. Klem, J.; Chyi, J.I.; Morkoc, H.; Ihm, Y.E.; Otsuka, N. (Sandia National Labs., Albuquerque, NM (USA); Illinois Univ., Urbana (USA). Coordinated Science Lab.; Purdue Univ., Lafayette, IN (USA). School of Materials Engineering). 1988. Contract AC04-76DP00789. 6p. (CONF-880141—1). NTIS, PC A02. Order Number DE88003841/JAW.

From Innovative science and technology symposium; Los Angeles, CA, USA (13 Jan 1988).

GaAs/sub 0.5/Sb/sub 0.5/ grown on InP by molecular beam epitaxy (MBE) has been characterized by transmission electron microscopy and variable temperature Hall measurements. Unintentionally doped layers are p-type with measured hole concentrations of 1-3 x 10^{16} cm^{-3} at 300K. The behavior of the Hall coefficient as a function of temperature is found to be well-described in the temperature range 30K$<$T$<$300K by a two-acceptor model. Intentional Si doping of the GaAs/sub 0.5/Sb/sub 0.5/ layers leads to relatively uncompensated p-type conductivity. Hole mobilities in these layers are generally less than 100 cm^2/Vs at 300K as a result of compositional fluctuations which result from the metastable nature of these films. In addition, hole mobilities are anisotropic and reflect an unusual asymmetry in the film microstructure which can be observed by transmission electron microscopy. 14 refs., 3 figs., 2 tabs.

18714 (UCID—20839-87-3) Abrasion and impact resistant coatings. Steele, W.A.; Mohr, P.B.; Leider, H.R. (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 21p. NTIS, PC A03; 3; GPO Dep. Order Number DE88003562/JAW.

The study of the application of free filamentary composites in "pile"-like structures and linings is aimed at cost effective alternatives to the life limiting abrasive and galling wear experienced in solid member flow systems and system elements. The basic approach is to reduce the intensity of interaction between flowing fluid and container to a level which results in little or no abrasive or fretting wear. In the case of flow borne particulates especially, the objective is to select filament materials and geometries which singly and in composite are sufficiently strong to preclude single particle (event) failure but sufficiently flexible to allow essentially damage-free passage. Early evidence is that this condition is primarily dependent on particle energy and filament strength, although there may also be fatigue, especially acoustic involvement. Our thinking to date has been on wear and acoustic fatigue resistant linings for conduit, flow control, particle control, and separation and drag resistant sealing. Both analytic and test studies have been undertaken. Initial work has been aimed at direct determination of basic characteristics of drag and damage threshold. 3 refs., 13 figs., 1 tab.

18715 (UCRL—15977) Mechanical characterization of IM7/8551-7 carbon/epoxy under biaxial stress: [Final report]. Colvin, G.E. Jr.; Swanson, S.R. (Utah Univ., Salt Lake City (USA). Dept. of Mechanical Engineering). 13 Nov 1987. Contract W-7405-ENG-48. 24p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004058/JAW.

This is the final report on an investigation to evaluate the mechanical response of Hercules IM7/8551-7 carbon/epoxy, which is a high strength, high elongation fiber and a high toughness resin system used in a prepreg form. The material characterization involved testing both laminate and lamina forms under a wide range of biaxial stress states. Tubular specimens were employed that have been designed to eliminate undesirable end effects, permitting uniform stress states to be achieved. Quasi-isotropic [90/+-45/0]/sub ns/laminates and [90]/sub 16T/ lamina specimens were loaded under combinations of internal pressure, axial load, and torsion. Both stiffness and strength data were obtained under these multiaxial stress conditions. The measured laminate stiffnesses correlated well using classical laminated plate theory, and that laminate failure occurred in the two separate modes of matrix cracking and fiber failure. Like the previously examined carbon/epoxy systems, laminate failure could be predicted by using a fiber failure criterion to identify the critical plies and critical load levels. It was found that either maximum fiber stress or fiber direction strain could be used as a failure criterion on a ply level. 16 refs., 10 figs., 3 tabs.

18716 Photoluminescence of CuInSe/sub 2/ and its intrinsic defect states. Abou-Elfotouh, F.; Alkuhaimi, S.; Moustafa, R.; Dunlavy, D.J.; Kazmerski, L.L. (Solar Energy Research Institute, 1617 Cole Blvd., Golden, CO 80401). pp 770-774 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—). Contract AC02-83CH10093.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

Photoluminescence emission spectra of CuInSe/sub 2/ crystals with various molecularity and stoichiometry deviations are investigated before and after heat treatments in air at temperatures between 200 and 400°C. Compositional depth profiles of Cd/CuInSe/sub 2/ heterojunctions after heating in air at 200-250°C are obtained and the results indicate In and Cu outdiffusion at the interface. On the basis of the PL spectra and the expected intrinsic defects in the chalcopyrite CuInSe/sub 2/, energy band diagrams have been proposed to identify the active intrinsic defects in CuInSe/sub 2/ and to determine their energy location. Accordingly, In-rich material has two acceptor states due to V/sub Cu/ and Se/sub i/ defects, and three donors due to In/sub Cu/, In/sub i/ and V/sub Se/. The origins of the two acceptor states in the Cu-rich material are V/sub In/ and Cu/sub In/ while donors are attributed to Cu/sub i/ and T/sub Se/ defects. The PL data are utilized to define the electrically-active defects in an effort to correlate the cell performance with the intrinsic defect state behavior in CuInSe/sub 2/. It is deduced that annealing at 200°C improves the cell performance by increasing the net concentration of the acceptor states in the CuInSe/sub 2/ base, contributing to a conductivity type-conversion of n-type material. A net excess of donors is created due to heat treatments at temperatures above 250°C, correlating with a deterioration of cell performance.

18717 Determination of the void fraction in hydrogenated amorphous silicon carbon. Menna, P.; Mahan, A.H.; Tsu, R. (Solar Energy Research Institute, Golden, CO 80401). pp 832-834 of Nineteenth IEEE photovoltaic specialists conference, 1987. (Conference Record). Piscataway, NJ; IEEE Service Center (1987). (CONF-870528—). Contract AC02-83CH10093.

From 19. IEEE photovoltaic specialists conference; New Orleans, LA, USA (4 May 1987).

The authors' present their measurements of the void content of a-SiC:H, obtained both by direct density measurements using a flotation method, and also by optical dielectric constant values applied to a void-substance composite. The authors' results are important for a better characterization of the microstructural parameter obtained from the upshifted infrared stretching frequency, and the shapes of the void structure.

18718 Properties of the interface between amorphous silicon and nitride. Tsai, C.C.; Street, R.A.; Ponce, F.A.; Anderson, G.B. (Xerox PARC, 3333 Coyote Hill Road, Palo Alto, CA 94304). pp 351-360 of Materials issues in amorphous semiconductor technology. Adler, D.; Hamakawa, Y.; Madan, A. Pittsburgh, PA; Materials Research Society (1986). (CONF-860445—).

From Materials Research Society spring meeting; Palo Alto, CA, USA (15 Apr 1986).

The structural, compositional and electronic properties of the a-Si:H/a-SiN/sub x/:H interface are reported. High resolution TEM and light/dark ESR studies conclude that the interface has a finite width of the order of 10 A. In addition, there is a high density of charges residing near the interface. Band bendings occur in both a-Si:H and a-SiN/sub x/:H, resulting in few neutral dangling bonds in the a-Si:H/a-SiN/sub x/:H multilayer structure. The depletion width in the nitride is of the order of 100 A. The slow decay of the LESR in multilayers with thin sublayers is attributed to charges trapped in the slow states in the nitride.

18719 Preliminary evaluation of some commercial polyurethane adhesives for possible weapons applications. Hoffman, D.M.; Kong, F.M.; Chiu, I.L. (Lawrence Livermore National Lab., Livermore, CA 94550). pp 382-387 of ANTEC '86: Plastic-value through technology. Brookfield Center, CT; Society of Plastic Engineers (1986). (CONF-8604120—). Contract W-7405-ENG-48.

From American Society of Plastics Engineers conference; Boston, MA, USA (28 Apr 1986).

This report contains the results of preliminary screening tests on two-component, ambient-cure polyurethane adhesives. The following design requirements were used as guidelines to distinguish desirable polyurethanes: (1) High purity, i.e., inorganic fillers or high catalyst concentrations are unacceptable. (2) Initial viscosity of approximately 40 Pa-s. (3) Working time of at least 1 h. (4) Cure time such that the adhesive has sufficient bond strength to permit removal of tools and clamping fixtures after 16 h or for some applications, 4 to 8 h. (5) Adhesive tensile strength to metals and high explosives of approximately 7 MPa. Some applications require 10 MPa breaking stress. (6) Low modulus and some elasticity over the -54 to 74°C temperature range. (7) Compatibility with high explosives and other weapons components with service life of 20-25 years. These design requirements fall into five structure-property categories which were used to identify particular screening tests for comparison of various commercial urethanes. The isocyanate, chain extender, polyol, and inorganic filler are of interest because of the purity requirement. Elemental analysis of metals and nonmetals was used to determine atomic composition and the presence of trace metal catalysts. Fourier transform infrared (FTIR) and high performance liquid chromatography (HPLC) were used to identify functional groups, and provide a rough estimate of amounts of components in uncured adhesives. Inorganic filler content was estimated from thermogravimetric analysis (TGA).

18720 (CONF-8709188—2) Enhanced erosion at the edges of glass rods and second-phase particles. Ahmed, T.; Kosel, T.H. (Notre Dame Univ., IN (USA). Dept. of Materials Science and Engineering). 1987. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004654/JAW.

From 7. international conference on erosion by liquid and solid impact; Cambridge, UK (7 Sep 1987).

The effect of enhanced material removal at the edges of pyrex glass rods and plates due to edge spalling during particle impact erosion (the edge effect) has been studied in order to simulate the erosion of discrete second-phase particles in alloys. The ratio of the rate of length change of rods to the rate of thickness change of plates, E/sub r//E/sub p/, has been taken as a measure of the edge effect. As predicted by a simple model, both E/sub r//E/sub p/ and the width of the rounding at the edges of the plates increased dramatically with increasing erodent particle size or velocity, and E/sub r//E/sub p/ increased rapidly with decreasing rod size. E/sub r//E/sub p/ values as high as 70 were observed. It is shown that the data for E/sub r//E/sub p/ for one erodent particle size at four velocities, and those for four erodent sizes at one velocity, can be plotted on a single curve by normalizing the rod

diameters with respect to the widths of rounding of the plates. 8 refs., 17 figs.

18721 (DOE/PC/91101—T5) Sulfur dioxide removal from flue gases by supported copper and iron absorbents: Technical report No. 5, August 16, 1987-November 15, 1987. Melson, G.A. (Virginia Commonwealth Univ., Richmond (USA). Dept. of Chemistry). 1987. Contract FG22-86PC91101. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004202/JAW.

Work continued on the preparation, characterization and evaluation of Cu/Al_2O_3 sorbents prepared from copper(II) acetate by using the extraction technique and from copper(II) nitrate. For the sorbents prepared from copper(II) acetate after heating up to ~400°C and for sorbents prepared from copper(II) nitrate, some of the spheres had black particles adhered to the surface, which were bulk copper(II) oxide, CuO, resulting from the decomposition of copper(II) acetate that was not incorporated into the alumina framework of the sphere. Some sorbents were then washed and comparisons of SO_2 adsorption made. The presence of CuO seemed to inhibit the sorption process. X-ray photoelectron spectra of Cu/Al_2O_3 sorbents before washing were obtained. 2 refs., 1 fig. (CBS)

18722 (PB—88-127857/XAB) Effects of aviation fluids on carbon fibre composite material. Halloff, E.; Holmberg, B. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Sep 1987. 18p. (In Swedish). (FOA-C—20674-2.6). NTIS, PC E03/MF A01.

Unloaded specimens of carbon-fiber composite materials were exposed to ten aviation fluids, that is, oils, fuels, hydraulic fluids, anti-icing fluids, cooling fluids and fire-retarding agents at room temperature and in some cases at elevated temperatures. The effect was determined in terms of changes of the mechanical properties of the exposed specimens.

18723 (UCID—21293) Kinetics of polymer decomposition. Burnham, A.K.; Braun, R.L. (Lawrence Livermore National Lab., CA (USA)). Dec 1987. Contract W-7405-ENG-48. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005500/JAW.

Thermal decomposition rates at heating rates ranging from 5 to 60°C/min are reported for 11 polymers. Rates were measured using a Rock Eval II apparatus, which uses a flame ionization detector to detect total evolved non-oxygenated carbon. Reaction rates were fitted to a variety of kinetic models, some involving distributions of activation energies. We found that poly(methyl methacrylate), poly(ethyl methacrylate), and poly(vinyl acetate) required two distinct reactions, which we assumed to be parallel. Many of the polymers did not fit well to any of the rate laws considered. One common problem was that the reaction profile was narrower than a first order reaction with an activation energy that matches the shift of T/sub max/ with heating rate, but it was often not the correct shape to be fitted satisfactorily by an nth-order reaction. We compare our observations with results for one Green River shale, whose decomposition is also sharper than a single first-order reaction, but whose profile is compatible with a fractional-order reaction. We discuss the implications of these problems on the ability to estimate decomposition rates at greatly different thermal histories. 20 refs., 7 figs., 5 tabs.

18724 (CEA-CONF—9140) Influence of simultaneous or sequential test conditions in the properties of industrial polymers, submitted to PWR accident simulations. Carlin, F.; Alba, C.; Chenion, J.; Gaussens, G.; Henry, J.Y. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Oct 1986. 39p. (In French and English). (CEA-DAS—343; CONF-8709230—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751861/JAW.

From International topical meeting on the operability of nuclear power systems in normal and adverse environments; Albuquerque, NM, USA (29 Sep 1987).

The effect of PWR plant normal and accident operating conditions on polymers forms the basis of nuclear qualification of safety-related containment equipment. This study was carried out on the request of safety organizations. Its purpose was to check whether accident simulations carried out sequentially during equipment qualification tests would lead to the same deterioration as that caused by an accident involving simultaneous irradiation and thermodynamic effects. The IPSN, DAS and the United States NRC have collaborated in preparing this study. The work carried out by ORIS Company as well as the results obtained from measurement of the mechanical properties of 8 industrial polymers are described in this report. The results are given in the conclusion. They tend to show that, overall, the most suitable test cycle for simulating accident operating conditions would be one which included irradiation and consecutive thermodynamic shock. The results of this study and the results obtained in a previous study, which included the same test cycles, except for more severe thermo-ageing, have been compared. This comparison, which was made on three elastomers, shows that ageing after the accident has a different effect on each material.

18725 (CEA-CONF—9141) Ageing effects of polymers at very low dose-rates. Chenion, J.; Armand, X.; Berthet, J.; Carlin, F.; Gaussens, G.; Le Meur, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete). Oct 1986. 41p. (In French and English). (CEA-DAS—344; CONF-8709230—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751862/JAW.

From International topical meeting on the operability of nuclear power systems in normal and adverse environments; Albuquerque, NM, USA (29 Sep 1987).

The equipment irradiation dose-rate into the containment is variable from 10/sup -6/ to 10/sup -4/ gray per second for the most exposed materials. During qualification, safety equipments are submitted in France to dose-rates around 0.28 gray per second. This study purpose is to now if a so large irradiation dose-rate increase is reasonable. Three elastomeric materials used in electrical cables, o'rings seals and connectors, are exposed to a very large dose-rates scale between 2.1.10/sup -4/ and 1.4 gray per second, to 49 KGy dose. This work was carried out during 3.5 years. Oxygen consumption measurement of the air in contact with polymer materials, as mechanical properties measurement show that: - at very low dose-rate, oxygen consumption is maximum at the same time (1.4 year) for the three elastomeric samples. Also, mechanical properties simultaneously change with oxygen consumption. At very low dose-rate, for the low irradiation doses, oxygen consumption is at least 10 times more important that it is showed when irradiation is carried out with usual material qualification dose-rate. At very low dose-rate, oxygen consumption decreases when absorbed irradiation dose by samples increases. The polymer samples irradiation dose is not still sufficient (49 KGy) to certainly determine, for the three chosen polymer materials, the reasonable irradiation acceleration boundary during nuclear qualification tests.

18726 (CONF-871147—4) Molecular dynamics of laser ablation of a polymer coating. Noid, D.W.; Gray, S.K. (Oak Ridge National Lab., TN (USA); Northern Illinois Univ., Dekalb (USA)). 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004337/JAW.

From 3. international laser science conference; Atlantic City, NJ, USA (1 Nov 1987).

Large-scale molecular dynamics calculations have been carried out to simulate laser ablation on a polymer surface. The model consisted of a polyethylene chain with 400 CH_2 units placed on a polymer surface. A laser excitation was simulated by giving a small portion of the polymer chain a nonequilibrium momentum distribution. The excitation energy threshold for fragmentation of the polymers was found to be quite large, owing to the tendency of the system to transfer large amounts of vibrational energy along the chain. 7 refs., 4 figs.

18727 (SAND—87-1588C) Buried silicide synthesis and strain in cobalt-implanted silicon. Barbour, J.C.; Picraux, S.T.; Doyle, B.L. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 7p. (CONF-871124—51). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003806/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Silicon (001) substrates were implanted with 350 keV Co at room temperature and 450°C with fluence of from 1 x 10^{17} Co/cm^2 to 6 x 10^{17} Co/cm^2. All samples were annealed at 1000°C in order to form the $CoSi_2$ phase. Concentration profiles were determined with Rutherford backscattering spectrometry (RBS), and the associated strain profiles were analyzed with double-crystal x-ray rocking curve measurements. Ion channeling was also used to characterize the silicide formation and crystal quality. An implantation of 6 x 10^{17} Co/cm^2 at 450°C forms a single-crystal $CoSi_2$ layer while lower fluences do not. A continuous, buried $CoSi_2$ single-crystal layer is formed for the 3 x 10^{17} Co/cm^2 sample implanted at 450°C and annealed at 1000°C. The continuous $CoSi_2$ layer is thicker than the critical layer thickness for a fully coherent film, and therefore the layer partially relaxes. A relaxation of 50% of the fully coherent value is observed for this buried silicide system. 5 refs., 4 figs., 1 tab.

18728 **Time-resolved and post-irradiation studies of the interaction of high-power pulsed microwave radiation with silicon.** James, R.B.; Bolton, P.R.; Alvarez, R.A.; Valiga, R.E.; Christie, W.H. (Sandia National Labs., Livermore, CA 94550). pp 153-160 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The authors measured the microwave-induced damage to the near-surface region of silicon for 1.9-μs pulses at a frequency of 2.856 GHz and a pulse power of up to 7.2 MW. Rectangular samples were irradiated in a test section of WR-284 waveguide that was filled with freon to a pressure of 30 psig. Incident, transmitted and reflected powers were monitored with directional couplers and fast diodes. The results of the time-resolved optical measurements show that the onset of surface damage is accompanied by a large increase in the reflected power. Examination of the irradiated surfaces shows that the degree of damage is greatest near the edges of the samples. Using secondary ion mass spectrometry to profile the implanted As, the authors find that the microwave pulses can melt the near-surface region of the material for pulse powers exceeding a threshold value.

18729 **Time-resolved picosecond reflectivity study of laser-excited layered compounds.** Huang, C.Y.; Malvezzi, A.M.; Bloembergen, N.; DiSalvo, F.J. Jr. (Los Alamos National Lab., Los Alamos, NM). pp 269-274 of Beam-solid interactions and transient processes. Thompson, M.O.; Picraux, S.T.; Williams, J.S. Pittsburgh, PA; Materials Research Society (1987). (CONF-861207—).

From Materials Research Society fall meeting; Boston, MA, USA (1 Dec 1986).

The authors have employed the pump-and-probe technique to perform picosecond time resolved measurements of the reflectivity changes in two archetypal layered compounds, 1T-TiS/sub 2/ and 1T-TiSe/sub 2/ probed at 1.064 μm after pumping by 20 ps, .532 μm laser pulses. At the threshold fluence, — 40 mJ/cm/sup 2/ , the reflectivity drops sharply, marking the occurrence of a phase transformation on the surface of the sample. Above threshold, the reflectivity reaches a value as low as —0.1 at high fluences, strongly suggesting that, like in graphite, the high temperature phase is not metallic.

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REFER ALSO TO CITATION(S) 18537

18730 **(CONF-8703238—) Quantum chemistry, solid-state theory, and computational methods: Proceedings: Quantum chemistry symposium No. 21.** Loewdin, P.O.; Oehrn, N.Y.; Sabin, J.R.; Zerner, M.C. (eds.). (Wiley (John) and Sons, New York (USA)). 1987. Contract FG03-85CE90229;FG05-87ER60523. 745p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE88005614/JAW.

From International symposium on quantum chemistry, solid-state theory, and computational methods; Marineland, FL, USA (12 Mar 1987).

Seventy-eight papers and abstracts are included. Selected papers were processed individually for the data base. (DLC)

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 17566, 17715, 17715, 17747, 17853, 17854, 18566, 18686, 18822, 18843, 19244, 19246, 19444, 19888, 20634

18731 **(BARC—1351) Analytical Chemistry Division: annual report (for) 1985.** Mahadevan, N. (comp.). (Bhabha Atomic Research Centre, Bombay (India)). 1986. 94p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88701236/JAW.

An account of the various activities of the Analytical Chemistry Division of the Bhabha Atomic Research Centre, Bombay, during 1985 is presented. The main function of the Division is to provide chemical analysis support to India's atomic energy programme. In addition, the Division also offers its analytical services, mostly for measurement of concentrations at trace levels to Indian industries and other research organization in the country. A list of these determinations is given. The report also describes the research and development (R and D) activities - both completed and in progress, in the form of individual summaries. During the year an ultra trace analytical laboratory for analysis of critical samples without contamination was set up using indigenous material and technology. Publications and training activities of the staff, training of the staff from other institution, guidance by the staff for postgraduate degree and invited talks by the staff are listed in the appendices at the end of the report. (M.G.B.).

18732 **(BARC—1368) Spectroscopy Division progress report for January 1985-December 1986.** Bellary, V.P.; Balasubramanian, T.K. (eds.) (Bhabha Atomic Research Centre, Bombay (India). Spectroscopy Div.). (Bhabha Atomic Research Centre, Bombay (India)). 1987. 254p. NTIS (US Sales Only), PC A12/MF A01. Order Number TI88701409/JAW.

The present report describes the activities of the Spectroscopy Division during the period January 1985-December 1986. Besides meeting the analytical requirements connected with the nuclear energy programmes and the related research and development projects, the Division has continued its efforts to develop and set-up new techniques to improve the speed and efficiency of the analytical capabilities and carry out basic research on atomic and molecular systems of importance to the programmes of the research centre. In the first section of the report, two feature articles, one on Laser Magnetic Resonance Spectroscopy and the other on Nuclear Spins, Moments and Charge Radii of short-lived isotopes and isomers using Laser Spectroscopic Techniques are included. The second section deals with the characterisation of the materials using optical emission, X-ray fluorescence and X-ray excited optical luminescence techniques. Work connected with basic research on atomic and molecular systems is described in the third section. Work on atomic systems includes high resolution studies on rare-earth ions in free and condensed states and the evaluation of the nuclear properties of short-lived radioactive elements. Work on molecular systems includes theoretical aspects pertaining to rotational intensities in forbidden transitions of diatomic molecules, high resolution spectral studies of diatomic molecules and free radicals, laser spectroscopy of alkali dimers. The fourth and fifth sections deal with the work concerning the designing and fabrication of sophisticated optical equipments and electronic components and system required for the various research and development programmes in the Division. Members of the Division continued to participate in the teaching programmes, guiding research leading to M.Sc. and Ph.D. degrees, training in spectrochemical analysis and in symposia and conferences. These activities are described in the last section of the report.

18733 **(ENEA-RT-PAS—86-14) Software quality control for gamma spectrometry. Routine quality for the doublet resolution of spectran-F.** Monte, L. (ENEA, Rome (Italy)). 1986. 21p. (In Italian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701272/JAW.

One of major problems with wich the quality control program of an environmental measurements laboratory is confronted is the evaluation of the performances of software packages for the analysis of gamma-ray spectra. A program of tests for evaluating the performances of the software package (SPECTRAN-F, Canberra Inc.) used by our laboratory is being carried out. In this first paper the results of a preliminary study concerning the evaluation of the performance of the doublet analysis routine are presented.

18734 **(LBL—24317) Channelling enhanced microanalysis: A high resolution analytical technique for atomic site and species determination.** Krishnan, K.N. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 14p. (CONF-880148—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004504/JAW.

From Indo-U.S. workshop: advanced techniques for microstructural characterization; Bombay, India (11 Jan 1988).

The formulation, development and applications of novel crystallographic technique to determine sepcific-site occupations of elemental additions in crystalline materials, using the channeling or Borrman effect in electron diffraction, is reviewed. This technique is based on the effect of incident beam orientations on the intensities of either the characteristic x-ray emissions or the characteristic electron energy-loss edges. The formulation of the technique under both planer and axial channeling conditions for crystalline materials is presented. In general, this technique can distinguish neighbors in the periodic table; involves no adjustable parameters, external standards or special specimen preparations; is applicable to trace elemental concentrations (0.2-0.3 wt % or 10^{25} atoms/m^3); is very accurate and can be applied routinely at high spatial resolutions (~10-40nm). In the EELS formulation the technique can also provide specific site valence information. Finally, applications of this technique to site-occupation studies in a variety of materials is outlined. 35 refs., 6 figs., 1 tab.

18735 **High selectivity isotope analysis.** Engleman, R. Jr.; Keller, R.A.; Miller, C.M.; Parent, D.C.; Fairbank, W.M. Jr.; LaBelle, R.D.; Lee, S.-A.; Riis, E. (Los Alamos National Lab., NM, USA; Colorado State Univ., Fort Collins, USA. Dept. of Physics). pp 127-132 of Resonance ionization spectroscopy 1986. Proceedings of the third international symposium on resonance ionization spectroscopy and its applications held at the University College of Swansea, Wales, on 7-12 September 1986. Hurst, G.S.; Morgan, C.G. (eds.). Bristol, England; Institute of Physics (1986). (CONF-8609132—).

From Resonance ionization spectroscopy and its application; Swansea, UK (7 Sep 1986).

Price Pound 35.00.

The dynamic range and accuracy of low abundance isotope measurements can be increased by: 1) isotope selective photoionization and 2) laser induced fluorescence (LIF) to interrogate ions in overlapped isotope peaks as they exit the mass spectrometer. In this paper the authors demonstrate the use of Resonance Ionization Spectroscopy to acquire the high resolution spectra of rare isotopes necessary to affect isotope selective photoionization. Preliminary results are also presented on LIF of accelerated Mg/sup +/ ions as a step towards probing ions as they exit a mass spectrometer.

18736 **Two-color, Doppler-free ionization of molecular hydrogen for isotopic analysis.** Hessler, J.P.; Glab, W.L. (Argonne National Lab., IL, USA). pp 183-187 of Resonance ionization spectroscopy 1986. Proceedings of the third international symposium on resonance ionization spectroscopy and its applications held at the University College of Swansea, Wales, on 7-12 September 1986. Hurst, G.S.; Morgan, C.G. (eds.). Bristol, England; Institute of Physics (1986). (CONF-8609132—).

From Resonance ionization spectroscopy and its application; Swansea, UK (7 Sep 1986).

Price Pound 35.00.

The authors present a three-step ionization scheme which will selectively ionize any isotopic variant. The projected isotopic selectivity is sufficient to detect tritium hydride at ambient concentrations without the need of mass analysis. The efficiency of the ionization process is high enough to allow work on small samples. The technique can be applied to many areas of research. The physical mechanisms which govern the conflicting objectives of both high isotopic selectivity and detection efficiency can be applied to any molecular system.

18737 **(BARC—1325) Setting-up of a direct reading emission spectrometer and its adaptation for plutonium handling.** Page, A.G.; Godbole, S.V.; Kulkarni, M.J.; Porwal, N.K.; Thulasidas, S.K.; Sastry, M.D.; Srinivasan, P.S. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703139/JAW.

A Jarrell-Ash 750 AtomComp 1100 series direct-reading emission spectrometer was set up, and its performance features were checked with regard to analysis of uranium-based samples using d.c. arc/inductively coupled argon-plasma excitation techniques. The instrument has been subsequently modified to enable handling of plutonium-based samples. The modifications include building up of a specially designed glove box around the excitation sources and consequent changes in the electro mechanical controls associated with them. The modified system was extensively used for the trace metal assay of FBTR fuel sample. 15 references, 6 figures, 6 tables.

18738 **(BARC—1355) D.C. arc emission spectrographic determination of medium and low volatile elements in U/sub 3/O/sub 8/ using a mixed carrier : AgCl + SrF/sub 2/.** Bhide, M.K.; Bhandiwad, V.R.; Kumar, Mithilesh; Dalvi, A.G.I.; Sastry, M.D. (Bhabha Atomic Research Centre, Bombay (India)). 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701240/JAW.

An emission spectrographic method for the determination of impurities having wide range of volatilities has been developed using carrier distillation technique enabling simultaneous determination of refractory elements and other trace metals. To evolve a carrier composition suitable for this purpose different carriers with varying composition and proportions were investigated. These experiments have shown that 10 per cent mixture of AgCl+SrF/sub 2/ in 4:1 proportion gives the optimum results. The lowest limits of determination lie in the range 0.2 to 10 ppm based on 100 mg charge. 9 refs., 5 tables.

18739 **(BARC—1373) Simultaneous spectrophotometric determination of tungsten and molybdenum with dithiol.** Navale, A.S. (Bhabha Atomic Research Centre, Bombay, India. Ore Dressing Section). (Bhabha Atomic Research Centre, Bombay (India)). 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701412/JAW.

Toluene-3,4-dithiol is a very sensitive reagent for the spectrophotometric determination of tungsten and molybdenum. Since the absorption spectra of the dithiol complexes of these two elements overlap, a separation of the two elements is carried out. This leads to time consuming extraction procedures. Measuring the absorption of the mixed complexes at two wavelengths and solving a set of simultaneous equations is also not favorable because a lot of time and effort is required for solving the simultaneous equations for each sample. A faster and simpler method is described here for the simultaneous determination of the two elements. The method is based on measurement of absorbance of the mixed complexes at three pre-selected wavelengths and simple calculations involving the absorbance differences. The criteria for selecting the three wavelengths and the theory are described. Application of the method for the determination of tungsten and molybdenum in ore samples is presented. The method is applicable to any similar system consisting of two interfering components. 4 figures, 2 tables, 6 refs.

18740 **(BDX—613-3872) Characterization and control of high-field NMR [nuclear magnetic resonance] analytical methods: Topical report.** Smith, R.E. (Allied-Signal, Inc., Kansas City, MO (USA). Bendix Kansas City Div.). Jan 1988. Contract AC04-76DP00613. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005539/JAW.

This report discusses the characterization and control of the analytical process used in high-field nuclear magnetic resonance (NMR) spectroscopy. The analytical operating conditions are described. A measurement and adjustment method has been selected, and analytical control limits established. Thus, it is now possible to monitor and adjust significant analytical variables to assure a consistent and repeatable analysis. 2 figs., 2 tabs.

18741 **(DOE/EV/10240—6) Synchronous fluorescence/ matrix isolation method for trace organic analysis.** Pardue, H.L. (Purdue Univ., Lafayette, IN (USA). Dept. of Chemistry). Nov 1987. Contract AC02-79EV10240. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005009/ JAW.

The primary object involved the development and evaluation of two-dimensional imaging detectors for synchronous fluorescence spectroscopy with adaptation to determination of trace amounts of organics such as polynuclear aromatic hydrocarbons (PAH's). A secondary objective was adaptation of chromatographic and matrix-isolation methods to this detection mode. The general plan was to illuminate (excite) the sample with several different wavelengths along its vertical axis and to use a polychromator at 90° to the excitation axis to resolve the fluorescent radiation. A two-dimensional imaging detector was used to monitor the resulting two-dimensional pattern of resolved fluorescence spectra (horizontal axis) at each of several excitation wavelengths (vertical axis). Data along one or more diagonal axes of the two-dimensional pattern were used as the synchronous fluorescence spectra at one or more wavelength differences ($\Delta\lambda$) between excitation and emission spectra. 13 figs., 5 tabs.

18742 **(DOE/PC/80518—T9) Surface chemistry of model Co-Mo catalysts supported on planar λ-Al_2O_3: Quarterly technical progress report for period September 1, 1987-November 30, 1987.** Sahin, T.; Ford, W.K. (Montana State Univ., Bozeman (USA)). 1987. Contract FG22-85PC80518. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003822/JAW.

This report describes the progress made during the first year of the investigations on the surface chemistry of model Co-Mo catalysts supported on planar λ-Al_2O_3, the objectives of which are: (1) develop and characterize a planar λ-Al_2O_3 surface and a model Co-Mo catalysts supported on this λ-Al_2O_3; (2) determine the adsorption characteristics of the model reactant molecules (thiophene for HDS, pyridine for HDN and cyclohexene for HYD) on the surface of the model Co-Mo catalysts; and (3) study the kinetics and mechanisms of the HDS, HDN and HYD reactions on the surface of the model Co-Mo catalyst.

18743 (IA—1427, pp 149) **Recent data on lead isotopic standards.** Platzner, I. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18744 (IA—1427, pp 154-155) **Characteristics of a low-power nitrogen-argon ICP for multielement analytical emission spectrometry.** Erlich, S.; Brenner, I.B.; Goldbart, Z. (Ministry of Energy and Infrastructure, Jerusalem, Israel. Geological Survey of Israel; Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18745 **(JINR—12-87-212) Anodic stripping voltammetric determination of lead, cadmium and thallium in natural brines.** Shishkin, S.V.; Dmitriev, S.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701495/JAW.

Submitted to the journal Zh. Anal. Khim. .

The method of lead, cadmium, and thallium determination by anodic stripping voltammetry in natural sodium chloride brines is developed. The method involves the preliminary extraction of Pb and Cd from brine by their co-crystallization with sodium chloride formed during evaporation, and its subsequent analysis. The determination of Tl is carried out in mother solution after ultraviolet irradiation. The relative standard deviation (n=5) is equal to 0.05(Pb, Cd) and 0.10 (Tl) when the element concentrations are determined at levels of 0.1-5 mg/l (Pbm Cd) and 0.02-0.2 mg/l (Tl). 13 refs.; 1 tab.

18746 (KFK—4177, pp 400-411) **Work on characterising waste.** Mainka, E.; Coerdt, W.; Geyer, F.; Koenig, W.; Mueller, H.G.; Unger, M.; Wertenbach, H. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Radiochemie). Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/ JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

In the context of characterising medium activity waste concentrates by chemical analysis, some new methods were developed and tested. Technetium was determined by emission spectroscopy in sample material diluted 1:10. Ion chromatography was selected for the anions F/sup -/, Cl/sup -/, SO/sub 4//sup 2-/, NO/sub 3// sup -/, PO/sub 4//sup -/ and oxalate in 1:100 medium activity waste, which represents a combination of anion exchange chromatography and conductivity measurement of the separate species. Using a second exchange column to prevent interfering electrolyte, it is possible to determine all these anions in one operation. High pressure liquid chromatography was chosen for EDTA, where a stochiometric Cu-EDTA compound is formed with the excess copper ions at pH 20, which is separated from the matrix and whose concentration is measured by means of UV absorption.

18747 (KFK—4177, pp 464-492) **Development of an ICP simultaneous emission spectrometer for the analysis of hot samples.** Mainka, E.; Mueller, H.G.; Neuber, J.; Braun, R. (Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R. Inst. fuer Radiochemie). Apr 1987. (In German). NTIS (US Sales Only), PC A23/MF A01. Order Number DE88751937/JAW. (PWA—89/86; CONF-8603235—).

From 6. status report of the Project Reprocessing and Waste Treatment (PWA) of Kernforschungszentrum Karlsruhe G.m.b.H.; Karlsruhe, F.R. Germany (13 Mar 1986).

An ICP AES spectrometer was developed, using an optical multi-channel analyser (OMA) and an additional long focal length highly resolving monochromator for the simultaneous multi-element analysis of highly radioactive solutions from reprocessing. Special aspects of the use of OMA detectors are explained and demonstrated with many illustrations.

18748 **(LBL—24098) Spectroscopic studies of the passive film on alkali and alkaline earth metals in non-aqueous solvents: A surface science approach: Final report.** Scherson, D.A.; Chottiner, G.; Herrara-Fierro, P.; Xing, Xuekun. (Case Western Reserve Univ., Cleveland, OH (USA)). Oct 1987. Contract AC03-76SF00098. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004895/JAW.

The feasibility of experiments in which, sub-, mono- and multilayer coverages of alkali metal are first vapor deposited on a well characterized single crystal specimen and then exposed to a non-aqueous solvent in ultra high vacuum has been demonstrated using K/Ag(111)-propylene carbonate PC, as a model system. The results obtained have indicated that Ag(111) exhibits no affinity for propylene carbonate at room temperature as monitored by work function, measurements and Auger electron spectroscopy, AES. In contrast, sizable changes in work function were observed for similar experiments involving Ag(111) covered by K even when the latter was present at coverages well below a monolayer. The AES spectra of the K/Ag(111)-PC surfaces layer showed C, and O peaks indicating that the presence of K on the surface leads to an increase in the sticking coefficient of PC on Ag(111). A series of AES spectra recorded after such reacted layers were heated at different tem-

peratures provided evidence that all the reaction products including K can be desorbed from the surface at about 600°C rendering a clean, highly ordered Ag(111) surface. 7 refs., 17 figs.

18749 (UCRL—97907) Enzyme-based fiber optic sensors. Kulp, T.J.; Camins, I.; Angel, S.M. (Lawrence Livermore National Lab., CA (USA)). Dec 1987. Contract W-7405-ENG-48. 6p. (CONF-880110—19). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005674/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

Fiber optic chemical sensors capable of detecting glucose and penicillin were developed. Each consists of a polymer membrane that is covalently attached to the tip of a glass optical fiber. The membrane contains the enzyme and a pH-sensitive fluorescent dye (fluorescein). A signal is produced when the enzyme catalyzes the conversion of the analyte (glucose or penicillin) into a product (gluconic or penicilloic acid, respectively) that lowers the microenvironmental pH of the membrane and consequently, lowers the fluorescence intensity of the dye. Each sensor is capable of responding to analyte concentrations in the range of ~0.1 to 100 mM. The penicillin optrode response time is 40 to 60 s while that for glucose is ~5 to 12 min. 7 figs.

18750 Direct detection of vacuum ultraviolet radiation through an optical sampling orifice: determination of nonmetals in gaseous samples by inductively coupled plasma atomic emission spectroscopy. LaFreniere, B.R.; Houk, R.S.; Wiederin, D.R.; Fassel, V.A. (Iowa State Univ., Ames). *Analytical Chemistry;* **60**: No. 1, 23-26(1 Jan 1988). Contract W-7405-ENG-82.

A copper cone with a sampling orifice is attached to the entrance slit chamber or a monochromator and inserted directly into an inductively couples plasma (ICP) to sample vacuum ultraviolet (vacuum UV) radiation emitted by the plasma. A unique interface with low dead volume (<40 μL) is used for introduction of gaseous samples directly into the axial channel of the ICP. Injection of a gaseous mixture of compounds containing the elements Br, C, Cl, and S results in detection limits of 50, 30, 80 and 20 pg, respectively. These detection limits are by far the best obtained for these elements by ICP atomic emission spectroscopy (AES) and are comparable to those obtained by AES with He plasmas. Precision of the analyte emission intensities is 2% relative standard deviation or better.

18751 Subfemtomole detection limit for amino acid determination with laser-induced crossed-beam thermal lens detection. Nolan, T.G.; Dovichi, N.J. (Oak Ridge National Lab., TN). *Analytical Chemistry;* **59**: No. 23, 2803-2805(1 Dec 1987).

Detection limits of 0.75 fmol of 18 (dimethylamino)azobenzenesulfonyl derivatized amino acids were achieved by using a 0.25-mm-diameter reverse-phase chromatography column and a laser-induced crossed-beam thermal lens detector. A pump laser power of 150 mW at 457.9 nm was employed. At the detection limit, only 50 analyte molecules are expected within the probe volume at the peak maximum.

18752 Resonance ionization mass spectrometry at Los Alamos National Laboratory. Miller, C.M.; Nogar, N.S.; Apel, E.C.; Downey, S.W. (Los Alamos National Lab., NM, USA). pp 109-114 of Resonance ionization spectroscopy 1986. Proceedings of the third international symposium on resonance ionization spectroscopy and its applications held at the University College of Swansea, Wales, on 7-12 September 1986. Hurst, G.S.; Morgan, C.G. (eds.). Bristol, England; Institute of Physics (1986). (CONF-8609132—).

From Resonance ionization spectroscopy and its application; Swansea, UK (7 Sep 1986).

Price Pound 35.00.

Two approaches to Resonance Ionization Mass Spectrometry (RIMS) at Los Alamos National Laboratory are discussed. The first is the use of continuous-wave dye lasers as the ionization source, and the use of pulse counting detection; and results are presented for lutetium and technetium. The second approach is the use of multiphoton resonances in the pulsed laser excitation of atoms. Experiments with 2 + 1 [photons to resonance plus photons to ionize] RIMS schemes for several elements are discussed.

18753 (BARC—1380) Mono-octylphenyl phosphoric acid (MOPPA) as an extractant for plutonium. Mithapara, P.D.; Shivarudrappa, V.; Marathe, S.G.; Jain, H.C. (Bhabha Atomic Research Centre, Bombay, India. Fuel Chemistry Div.). (Bhabha Atomic Research Centre, Bombay (India)). 1987. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701416/JAW.

Mono-octylphenyl phosphoric acid (MOPPA) was isolated from commercially available octyl phenyl acid phosphate in pure form. The product was characterised by melting point, elemental analysis, pKsub(a) measurements and its infra-red absorption spectrum. Using the isolated product, studies were carried out for the extraction of plutonium(IV) from nitric, sulphuric and phosphoric acid media with a view to see the applicability of the reagent for the recovery of plutonium from analytical wastes. The effects of acid concentration and the reagent concentration on the distribution ratio (D) were studied. This report describes the detailed procedure for the preparation of the pure product and the results of investigations on its use as an extractant for plutonium. 3 tables, 2 figures, 9 refs.

18754 (CONF-8608212—1) Reversed micellization in metal-organophosphorus extractant systems of commercial importance. Gaonkar, A.G.; Neuman, R.D. (Auburn Univ., AL (USA). Dept. of Chemical Engineering). 1986. Contract FG05-85ER13357. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004748/JAW.

From 6. international symposium on surfactants solution; New Delhi, India (18 Aug 1986).

The interfacial tension behavior in liquid/liquid organophosphorus extractant systems containing di(2-ethylhexyl)phosphoric acid (HDEHP) and metal ions such as Ca^{2+}, Cu^{2+}, Co^{2+}, Ni^{2+}, or Zn^{2+} was investigated. Data of vapor pressure osmometry and Karl Fischer titrimetry, in addition to those of interfacial tension, distribution equilibria and extraction kinetics, support the view that reversed micelles can form in extraction systems which employ HDEHP. 24 refs., 7 figs.

18755 (DOE/PC/90515—5) Entrainer effects in high pressure separation processes: Quarterly technical progress report for period September 15, 1987 to December 14, 1987. Donohue, M.D. (Johns Hopkins Univ., Baltimore, MD (USA). Dept. of Chemical Engineering). 1987. Contract FG22-86PC90515. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004671/JAW.

The goal of our spectroscopic work is to "gain sufficient understanding of the entrainer effect so that, ultimately, the optimal solvent and cosolvent can be chosen and solubilities predicted." Spectroscopic data will be used to test and improve, where necessary, the accuracy and predictive capability of APACT (the Associated Perturbed Anisotropic Chain Theory). Our plans are (1) to determine, by FTIR spectroscopy, the extent of hydrogen bonding in liquid and compressed gas mixtures of solvating and associating fluids, (2) to use phase equilibrium data and the results of our spectroscopic measurements to test APACT as a model for Lewis acid/base interactions in liquid or compressed gas mixtures, (3) to investigate the hypothesis that CO_2, as a solvent in compressed gas mixtures, acts as a Lewis acid (or base, depending on the acid/base properties of the other components in the mixture). To test this hypothesis, and to provide data to test APACT, mixtures of a compressed gas, an associating fluid (such as methanol) or a potentially solvating fluid (such as a ketone) will be analyzed for hydrogen bonding. Further experiments with CO_2 will be planned depending on the outcome of this first experiment. Liquid spectroscopy will be developed as a technique for obtaining data that can be used with APACT calculations to make predictions of the phase behavior and hydrogen bonding tendency of compressed gas mixtures. 6 figs.

18756 (IA—1427, pp 144) **Electrodeposition of trace metallic impurities. Dependence on the supporting electrolyte concentration - a comparison between bipolar and monopolar porous electrodes bipolar and monopolar porous electrodes.** Abda, M.; Oren, Y.; Soffer, A. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

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18757 (IA—1427, pp 145) **Electroadsorption of alumina particles on fibrous carbon and graphite electrodes.** Cohen, H.; Soffer, A.; Oren, Y. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18758 (BARC—1318) **Synthesis and characterisation of aliphatic long-chain sulfoxides.** Nagar, M.S.; Pai, S.A.; Ruikar, P.B.; Subramanian, M.S. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703136/JAW.

Although tributyl phosphate (TBP) has retained its unique place as an extractant in the purex process, newer extractants such as other trialkyl phosphates, phosphonates, and tertiary amines have been investigated as alternatives to TBP in fuel reprocessing. Investigations on the use of aliphatic long-chain sulfoxides for this purpose are being carried out. These extractants form species with actinides similar to those formed by TBP and have higher extractive power than TBP. In addition, their degradation products which are sulfides and sulfones are inert to extraction of fission-product elements. This report summarises the syntheses of eight long-chain aliphatic sulfoxides and their characterization by elemental analysis for carbon, hydrogen, and sulfur as well as the determination of their S=0 content by a nonaqueous potentiometric titration. The relative basicities of these sulfoxides have also been determined by measuring the equilibrium constants for the uptake of nitric acid by them. The S=0 stretching frequencies of these sulfoxides obtained from their infrared spectra are also given in this report. 14 references, 1 table.

18759 (DOE/ER/04694—4) **Low energy ion-molecule reaction dynamics and chemilonization kinetics: Progress report, February 1, 1985-January 31, 1988.** Farrar, J.M. (Rochester Univ., NY (USA)). 1988. Contract AC02-78ER04694. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004914/JAW.

The research program at Rochester is devoted to an understanding of the dynamics of elementary gas phase ionic reactions by using the molecular beam methods. We seek to elucidate pathways for energy disposal in elementary reactions, with the goal of using this information to understand the topology of the potential surfaces which govern the reaction, applying the results to ionic channels in combustion systems. We have made significant accomplishments in several distinct areas of research in crossed beam studies of ion-neutral reaction dynamics in the past three years. Our research has focused on the following topics and has resulted in 15 publications and submissions to major journals, with several additional manuscripts in preparation: dynamics of gas phase proton transfer reactions, gas phase carbon and methyl cation chemistry, reactive scattering from double minimum potentials, reactions of highly vibrationally excited ions: $NH_3^+ + D_2$, and electron and proton transfer reactions of anions. 9 refs.

18760 (DOE/ER/10830—6) **Model catalyst studies of SMSI [strong metal/support interactions] and the role of d-electrons in chemisorption and catalysis: Final report, January 15, 1982-September 30, 1987.** Henrich, V.E. (Yale Univ., New Haven, CT (USA). Dept. of Applied Physics). Nov 1987. Contract AC02-81ER10830. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004518/JAW.

The origin of strong metal/support interactions (SMSI) in the Rh/TiO_2 system through studies of model catalysts prepared on single-crystal supports has been investigated. The following areas were studied: processing and characterization of model Rh/TiO_2 catalysts, theoretical basis for the charge transfer model of a Pt atom supported on TiO_2, morphology of monolayer amounts of Rh and TiO_2, and electronic interactions in the Rh/TiO_2 system. Publications resulting from this research are appended. (CS)

18761 (DOE/ER/13299—T2) **[Diosmacycloalkanes as models for the formation of hydrocarbons from surface methylenes]: Progress report, April 1, 1987-March 31, 1988.** Norton, J.R. (Colorado State Univ., Fort Collins (USA)). 1988. Contract FG02-84ER13299. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005617/JAW.

A variety of osmium complexes with carbon monoxide and alkenes (ethylene, styrene, propylene) and their dissociation has been studied. (DLC)

18762 (DOE/ER/13430—3) **Reductive coupling of carbon monoxide to C_2 products: Progress report.** Templeton, J.L. (North Carolina Univ., Chapel Hill (USA)). 1 Nov 1987. Contract FG05-85ER13430. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004923/JAW.

Carbyne-carbonyl coupling reactions have been studied. The methyl substituted pyrazolye analog, T/sub p/ = HB (3,5-$Me_2C_3N_2H)_3$ has been examined. Coupling of carbonyl and thiocarbyne ligands can take place with added PEt_3 in the system. Molecular orbital studies of model Group VI complexes containing two carbynes have been completed. In addition, experimental efforts probing general ligand coupling reactions led to the preparation of Mo(II) carbonyl compounds. In order to explore alkyne reactions, $(dppe)_2$ $Ta(CO)_2$ Cl has been prepared, as well as related PMe complexes. 8 refs. (CS)

18763 (DOE/ER/13511—1) **Supported f-element organometallic complexes surface chemistry and catalysis: Technical progress report, March 15, 1987-December 28, 1987.** Marks, T.J.; Burwell, R.L. Jr. (Northwestern Univ., Evanston, IL (USA). Dept. of Chemistry). 1987. Contract FG02-86ER13511. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003988/JAW.

The goal of this research program is to understand how the reactivity of organometallic molecules is dramatically altered by adsorption on inorganic supports such as γ-alumina, silica, magnesium chloride, etc. While the initial focus of this research concerned the catalytic properties of organoactinides adsorbed on alumina, the effort has now expanded in a number of new directions. These include new supports, new surface spectroscopic techniques, detailed studies of reaction kinetics, new metals, and new connections with solution chemistry.

18764 (DOE/PC/70808—T3) **Intercrystalline anion exchange, sorption, and base catalysis: Quarterly progress report, July-September 1987.** Marcelin, G. (Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering). 1987. Contract FG22-84PC70808. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004673/JAW.

Efforts are continuing in elucidating the acid-base characteristics of the hydrotalcite-like materials and the effect that layer composition has on its ultimate properties. A series of Mg-Al hydrotalcite-like materials of varying Al/Mg ratio and with nitrate as the interlayer anion, have been prepared and characterized as to their physical properties. The acid-base characteristics were studied using 2-propanol decomposition as a test reaction. Ketone selectivity was found to be highest for the material with the highest aluminum content. 2 figs., 2 tabs.

18765 (DOE/PC/90526—5) **Partial oxidation of light alkanes in transition-metal ion containing zeolites: [Quarterly report, September 15, 1987-December 14, 1987].** (Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry). 1987. Contract FG22-86PC90526. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003810/JAW.

Scattered-wave X-alpha calculations of small transition-metal ion clusters are reported here. Calculations of nearly tetrahedral $(ZnO_4)^{-6}$ cluster predicted satisfactorily the energy of the center of the bandgap and valence band for bulk ZnO. However, they failed in predicting the correct width of these bands because of the small number of energy levels considered. Calculations of nearly tetrahedral $(CuO_4)^{-6}$ and of trigonal $(CuO_3)^{-4}$ clusters succeeded in predicting the d-d* electronic transitions observed for Cu(II) defects in different oxide matrices. The former accounted for substitutional copper in ZnO and the latter for Cu(II) in Si' or SII site of A and Y zeolites. A vacuum line designed for studying the title reaction has been mounted and tested. Its performance is reported here. 12 refs., 3 figs., 3 tabs.

18766 (IA—1427, pp 6-7) **Stochastic concept for diffusion processes with chemical reactions.** Karni, U.; Goldstein, M.; Bar-Ziv, E. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18767 (IA—1427, pp 7) **Multi-dimensional diffusion simulated by stochastic model.** Karni, Y.; Goldstein, M.; Bar-Ziv, E. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18768 (IA—1427, pp 7) **Simulation of diffusion and chemical reactions with cell-mixing. Stochastic model.** Karni, Y.; Goldstein, M.; Bar-Ziv, E. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18769 (IA—1427, pp 8) **Theory of laser catalyzed reactions: Pt. 1. Potential surfaces and transition dipoles in the Li+HCl reaction.** Zeiri, Y.; Shapiro, M. (Israel Atomic Energy Commission, Tel Aviv; Weizmann Inst. of Science, Rehovoth, Israel). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18770 (JINR—14-87-353) **Neutron diffraction refinement of CsHSO/sub 4/ superionic phase structure.** Balagurov, A.M.; Beskrovnyj, A.I.; Gordelij, V.I.; Vratislav, S.; Dlouga, M.; Datt, I.D.; Irak, Z.; Shuvalov, L.A. (Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of Neutron Physics; Ceske Vysoke Uceni Technicke, Prague, Czechoslovakia; Moskovskij Khimiko-Tekhnologicheskij Inst., USSR; Ceskoslovenska Akademie Ved, Prague. Fyzikalni Ustav; AN SSSR, Moscow. Inst. Kristallografii). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 5p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701496/JAW.

The superionic phase structure of the crystal CsHSO/sub 4/ (T/sub c/ ≅ 414 K) has been determined from neutron diffraction data. The volume centered tetragonal structure (sp.gr. I4/sub 1// amd, a=5.718 A, c=14.232 A) is in the state of dynamical disorder: the tetrahedron SO/sub 4/ occupies two positions with a tilting of +-20 deg around the c axis, the hydrogen atoms connect the tetrahedrons in the chain the direction of the [111] type. The proton conductivity proceeds by jump diffusion for the distances of 2.85 A, and 3.60 A along the [100] and [001] directions, respectively. With reducing temperature the subgroup phase transition occurs with one of the states beeing freezed down. 12 refs.; 4 figs.; 1 tab.

18771 (LBL—24254) **Preliminary results on the hydrolysis and carbonate complexation of dioxoplutonium(V).** Bennett, D.A.; Hoffman, D.C.; Nitsche, H.; Silva, R.J. (Lawrence Berkeley Lab., CA (USA); Lawrence Livermore National Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 22p. (CONF-870802—37). NTIS, PC A03. Order Number DE88004444/JAW.

From 194. American Chemical Society national meeting; New Orleans, LA, USA (30 Aug 1987).

The hydrolysis and carbonate complexation reactions of dioxoplutonium (V) were studied in near neutral aqueous systems. These experiments involved the addition of hydroxide or carbonate to Pu(V) in a perchorate medium. Change in the electronic adsorption spectra provided information about the chemical properties of Pu(V). The results indicate the Pu(V) does not hydrolyze below pH 7.15. In the carbonate complexation studies, log β_{11} was measured to be 4.4 +- 0.7. 5 figs., 3 tabs.

18772 (LBL—24359) **Reactive intermediates in organometallic chemistry.** Stoutland, P.O. (Lawrence Berkeley Lab., CA (USA)). Aug 1987. Contract AC03-76SF00098. 215p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88005329/JAW.

Chemical reactions, kinetics, thermodynamics, activation, and dissociation of bonds of organometallic compounds are discussed. In particular, results of thermolysis of iridium compounds and reaction intermediates are presented, as well as flash photolysis of several metal carbonyl species. 179 refs., 32 figs., 20 tabs. (CBS)

18773 (LBL—24404) **Surface science and catalytic studies of hydrocarbon skeletal rearrangements: The platinum and the bimetallic platinum-rhenium single crystal systems.** Godbey, D.J. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 245p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88005742/JAW.

Bimetallic surfaces were prepared by vapor deposition of Re onto Pt(111) and Pt(100), and of Pt onto Re(0001) and polycrystalline Re foils. Re was found to grow layer by layer on both Pt(111) and Pt(100); it formed an hexagonal close-pack hcp film on Pt(111) and a film on Pt(100). Pt was found to grow layer by layer on Re(0001) with the formation of an hcp film. Evidence for an electronic interaction between the two metals was shown by XPS because the 4f/sub 7/2/ peaks shifted to higher binding energies for both metals when Re was deposited on Pt. The addition of Re metal to Pt(111) caused a 4 to 8 kJ/mole decrease of the metal-hydrogen bond strength. Surfaces composed of between 0.2 to 0.35 monolayers of Re on Pt(111) displayed maximum low pressure adsorption capacities for H_2 and CO. Maximum rates of hydrogenolysis for reactions near atmospheric pressure were observed from all hydrocarbons studied and were obtained over bimetallic surfaces composed of Re and Pt in an atomic ratio of 2:1. Compared to a monometallic Pt(111) surface, 0.3 monolayers of Re on Pt(111) gave a surface that was as active as a clean Re(0001) surface for ethane hydrogenolysis, yet the hydrogen partial pressure dependence observed was closest to that obtained for Pt(111). An enhancement in the production rate of aromatics from n-hexane and cyclohexane indicates that Pt atoms with Re ligands are more active than monometallic Pt for this class of reactions. The isomerization rate of n-hexane was smaller in the presence of Re than on clean Pt due to decreased desorption of ring opening products from cyclic intermediates on the bimetallic surface. However, cyclization activity was not strongly effected by the addition of Re to Pt. The presence of Re on Pt resulted in a surface more resistant toward carbonaceous deposits.73 figs., 22 tabs.

18774 (SAND—87-1621C) **A new polymer-based hydrogen getter.** Gilliom, L.R. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-871124—26). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004538/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

Styrene-butadiene triblock copolymer PS-PB-PS was hydrogenated in the bulk using the Crabtree catalyst $[Ir(COD)(py)(tcyp)]PF_6$ (COD = 1,5-cyclooctadiene, py = pyridene, tcyp = tricyclohexylphosphine). Since this polymer/catalyst mixture reacts rapidly with hydrogen at ambient temperature and low hydrogen pressures, it should act as an effective hydrogen getter. 7 refs., 2 figs.

18775 Determination of phase composition of silicon nitride powders by silicon-29 magic angle spinning nuclear magnetic resonance spectroscopy. Carduner, K.R.; Carter, R.O. III; Milberg, M.E.; Crosbie, G.M. (Ford Motor Company, Dearborn, MI). *Analytical Chemistry;* **59**: No. 23, 2794-2797(1 Dec 1987). Contract AC05-84OR21400.

The use of solid-state ^{29}Si NMR spectroscopy to analyze Si_3N_4 powders is demonstrated for a series of commercial and research samples. In particular, two different commercial powders contain 20% and 30% amorphous Si_3N_4 content, as identified by the application of methods described herein. These same materials had been analyzed by X-ray diffraction as only crystalline Si_3N_4. NMR spectroscopy is capable of distinguishing among different amorphous silicon species normally found in preparations of Si_3N_4 powders. These include amorphous Si_3N_4, silicon oxynitrides, silicates, and elemental silicon. The measurement of concentration of these species is made for correlation with properties of powder sinterability.

18776 Cyclopolysilanes: structure, strain, and the form of the singly occupied molecular orbital in their radical anions. Grev, R.S.; Schaefer, H.F. III. (Lawrence Berkeley Lab., California). *Journal of the American Chemical Society;* **109**: No. 22, 6569-6577(28 Oct 1987). Contract AC03-76SF00098.

The cyclopolysilanes (SiH_2)/sub n/, n = 3 to 5, have been investigated via ab initio quantum mechanical methods. Strain energies are determined through the use of homodesmotic reactions, and the strain of the three-, four-, and five-membered silicon rings relative to each other and to the corresponding hydrocarbon rings is reasonably explained by consideration of angle strain, torsional strain, and substituent effects. Arguments of σ-aromaticity, which ascribe the apparent unusual stability of three-membered rings (3MR's) to delocalization of six σ electrons, fail to account for the observed data, and their fundamental assumption that force constants at one geometry can be used to predict strain energies at a vastly different geometry is seriously called to question. Finally, a model for the singly occupied molecular orbital (SOMO) of cyclopolysilane anion radicals is suggested by their studies which is π-bonding between the ring atoms and silicon-substituent antibonding. For reasons of symmetry, this π^* model readily explains available evidence from ESR and UV spectroscopy, but cannot easily explain results from recent ^{29}Si ENDOR studies. On the other hand, a recently developed σ^* model, which appears to account for the ENDOR results, seems at odds with the ESR and UV intensity data.

18777 Hetero-substituted cyclopolysilanes: unusual structures and a new model of bonding in 1,3-disubstituted four-membered rings. Grev, R.S.; Schaefer, H.F. III. (Lawrence Berkeley Lab., CA). *Journal of the American Chemical Society;* **109**: No. 22, 6577-6585(28 Oct 1987). Contract AC03-76SF00098.

The monosubstituted cyclopolysilanes (SiH_2)/sub n/X (X = CH_2, NH, O, PH, and S; n = 2 and 3) are investigated with ab initio quantum mechanical techniques. The monosubstituted four-membered rings do not exhibit any remarkable structural features, while all the monosubstituted three-membered rings have unusually short Si-Si bond distances and nearly planar Si-Si-H_2 units, which can be explained via Dewar's model of metal-olefin bonding. A simple extension of this model to the case of 1,3-disubstituted four-membered rings readily explains the unusual geometries found in many of these systems. This model is quite general and focuses on the ring orbitals themselves, unlike previous models which often invoked large lone pair-lone pair interactions to explain observed deviations from ideal square-planar geometries. Thus, it is applicable to both three- and four-membered substituted and unsubstituted rings alike. The bonding in cyclodisiloxane is described as that of a dibridged π-complex, and the bond between the silicons, if it exists, is most likely that of an unsupported π-bond.

18778 Nature of carbon-lithium bonding in dilithiated polynuclear aromatics: an MNDO study. Sygula, A.; Lipkowitz, K.; Rabideau, P.W. (Purdue School of Science, Indianapolis, IN). *Journal of the American Chemical Society;* **109**: No. 22, 6602-6605(28 Oct 1987).

An MNDO study shows that the nonsymmetric crystal structures of dilithionaphthalene and dilithioanthracene are not the result of crystal-packing forces, but rather reflect the internal minimum energy arrangement of the molecules considered. On the other hand, the optimal structures of the complexes of the respective dianions with two positive charge are symmetrical. This difference suggests that partial covalency of the carbon-lithium bonding may be responsible for the nonsymmetric arrangement becoming the most stable in the crystal state.

18779 ESR studies of the thietane and thiirane radical cations in freon matrices. Evidence for ethylene molecule extrusion from the σ^* thiirane dimer radical cation [C_2H_4S-SC_2H_4/sup .+/. Qin, X.Z.; Meng, Q.; Williams, F. (Univ. of Tennessee, Knoxville). *Journal of the American Chemical Society;* **109**: No. 22, 6778-6788(28 Oct 1987).

ESR spectroscopy has been used to study the structures and reactions of the radical cations produced from the three- and four-membered sulfur-containing ring compounds, thiirane and thietane, the radical cations being generated by γ irradiation of dilute solutions of the parent compounds in Freon matrices at 77 K. With use of $CFCl_3$ as the matrix, the monomer radical cations have been identified and characterized as having $^2B_1$ ring-closed structures with the unpaired electron localized on the sulfur atom. The hyperfine coupling to the four equivalent β-hydrogens in the thietane cation (31.1 G) is normal, but the corresponding value for the thiirane cation (16.1 G) is lower by almost a factor of 2, suggesting that hyperconjugation to methylene groups is much reduced in three-membered rings. In the more mobile $CFCl_2CF_2Cl$ and CF_3CCl_3 matrices, dimer radical cations of thiirane and thietane are produced by the combination of a monomer radical cation with a neutral molecule at low temperatures (< 100 K). ESR studies show that these dimer species are centrosymmetric, the binding between the molecules resulting from the formation of a 3-electron $\sigma^2\sigma^{*1}$ S-S bond. Both of the dimer cations are unstable above 105 K in the $CFCl_2CF_2Cl$ matrix, the thietane dimer radical cation decomposing to give the 2-thietanyl radical as a result of hydrogen atom or proton transfer, whereas the thiirane dimer radical cation undergoes a novel reaction involving the extrusion of an ethylene molecule.

18780 Clusters containing carbene ligands. The formation of a carbene ligand by C-H activation of a π-complexes iminium ligand. Adams, R.D.; Babin, J.E. (Univ. of South Carolina, Columbia). *Journal of the American Chemical Society;* **109**: No. 22, 6872-6873(28 Oct 1987).

Recently, there has been a flurry of interest in the nature of the activation of olefinic CH bonds by metal complexes. Studies have shown that the barriers to the activation of CH bonds of π-complexed olefins by mononuclear metal complexes are very large. Indeed, evidence has been presented which demonstrates that olefinic CH activation by certain mononuclear metal complexes occurs without precoordination of the olefin. By contrast olefininc CH activation by polynuclear metal complexes and on surfaces is a relatively facile process. In these cases, it is believed that the activation step is a two-center process in which the olefin is coordinated to one metal atom and the CH cleavage takes place by interaction at a vacant coordination site on a neighboring metal atom. Iminium ions, $H_2C{=}NR_2^+$, are isoelectronic to olefins, and they are known to form π-bonded complexes analogous to π-olefin complexes. In this communication is described the first example of a C-H activation of a π-complexed iminium ion and its conversion into a dialkylaminocarbene ligand.

18781 Synthesis of a heterobimetallic dihydride by the addition of a rhenium dihydride to a platinum(0) complex. Casey, C.P.; Rutter, E.W. Jr.; Haller, K.J. (Univ. of Wisconsin, Madison). *Journal of the American Chemical Society;* **109**: No. 22, 6886-6887(28 Oct 1987).

The authors have been searching for routes to heterobimetallic dihydrides since they anticipate that such compounds might be unusual reducing agents. Here they report the synthesis of a heterobimetallic dihydride by oxidative addition of a metal dihydride to a second metal center. The thermodynamic driving force for the process is the formation of a new metal-metal bond.

18782 Ethylene formation in the reduction of 1,4-dihaloalkanes with a nickel(I) macrocycle. Espenson, J.H.; Ram, M.S.; Bakac, A. (Iowa State Univ., Ames). *Journal of the American Chemical Society;* **109**: No. 22, 6892-6893(28 Oct 1987). Contract W-7405-ENG-82.

The nickel tetraaza macrocycle $Ni(tmc)^+$ reacts with 1,4-dihaloalkanes (halide = Br, I) to produce ethylene, eq 1. No $X-(CH_2)_4-X + 2Ni(tmc)^+ \rightarrow 2XNi(tmc)^+ + 2C_2H_4$ (1) cyclobutane or butenes were observed by VPC under any conditions, although suitable controls were performed to show that they would have survived the reaction conditions. 1-Bromobutane and minor amounts of n-butane (2-10%) result only when a deficient quantity of $Ni(tmc)^+$ is used. With excess $Ni(tmc)^+$, however, both byproducts are largely eliminated, and ethylene is formed in > 90% yield.

18783 The coordination cluster theory: Extension to multicomponent systems. Saboungi, M.L.; Caveny, D.; Bloom, I.; Blander, M. (Argonne National Lab., 9700 South Cass Avenue, Argonne, IL 60439-4837). *Metallurgical Transactions, [Section] A: Physical Metallurgy and Materials Science;* **18A**: No. 10, 1779-1784(Oct 1987). Contract W-31-109-ENG-38.

The coordination cluster theory, which has been shown to provide a good representation of the thermodynamic properties of a dilute solute in a binary solvent, is extended for multicomponent solvents. The extended theory permits one to predict activity coefficients of solutes in multicomponent solvents, based on values in the subsidiary binary systems. The theory takes into consideration three types of interactions, namely, those (i) between solute and solvent atoms, (ii) between solvent atoms that are near neighbors of the solute, and (iii) between solvent atoms not in the vicinity of the solute and all other solvent atoms. Calculations of the activity coefficients of oxygen dissolved in the Ag-Cu-Sn ternary solvent are in good agreement with measurements.

18784 Chemical stability of Na/sub 2/O-ZrO/sub 2/-Al/sub 2/O/sub 3/-SiO/sub 2/ glasses in sodium, sodium polysulfides, and sulfur. Bloom, I.; Bradley, J.; Roche, M.F. (Chemical Technology Div., Argonne National Lab., Argonne, IL 60439). *Journal of the Electrochemical Society;* **134**: No. 9, 2102-2118(Sep 1987). Contract W-31-109-ENG-38.

Glass compositions from the Na/sub 2/O-ZrO/sub 2/-Al/sub 2/O/sub 3/-SiO/sub 2/ system were tested for chemical stability by exposure at 400°C for 1000h in Na, S, Na/sub 2/S/sub 4/ and Na/sub 2/S/sub 3/. Weight-change data and results of microscopic analysis of glass samples after testing, taken together, indicated that the composition containing about 42 mole percent (m/o) Na/sub 2/O, 8 m/o Al/sub 2/O/sub 3/, and 5 m/o ZrO/sub 2/ (balance SiO/sub 2/) had a chemical stability in all four media comparable to that of β''-alumina. With this type of glass in all the media containing sulfur, just a slight increase in alumina (to 11 m/o) and zirconia (to 8 m/o) produced surface and internal cracks. Although the chemical stability data for the above glass are encouraging, cell tests are necessary to confirm these experiments.

18785 Zintl phase with a layered network structure, KSi_2As_3. Hurng, W.M.; Corbett, J.D.; Wang, S.L.; Jacobson, R.A. (Iowa State Univ., Ames). *Inorganic Chemistry;* **26**: No. 15, 2392-2395(29 Jul 1987). Contract W-7405-ENG-82.

The title compound is obtained in high yield from a two-step reaction of K with Si in sealed tantalum and then of that product with As in silica at 800-900°C. Ion exchange with NaI at 500 °C gives the sodium derivative. The structure of the purple KSi_2As crystals has been established by x-ray diffraction means at room temperature (orthorhombic, space group Pbam, Z = 4, a = 10.010 (4) A, b = 19.139 (8) A, c = 3.664 (1) A, R = 0.044 for 674 reflections, 2theta < 55°). The infinity $^2[Si_2As_3]^-$ anion layers may be generated by Si-Si bonding between puckered $Si_3As_3(As)$ rings to form chains followed by side-by-side condensation of these to sheets. The structure may be derived from the layered structure of SiAs in a concerted way through reductive ring opening and Si-Si bond formation. Comparisons are also made with more reduced Si-As anion chains and clusters and with the closely related Li_3NaSi_6. K_2SiAs_2 has also been synthesized and shown to be isostructural with K_2SiP_2. 20 references, 4 figures, 4 tables.

18786 Synthesis, characterization, low-temperature (50 K) neutron diffraction structure, and reactivity of chlorodihydridotetrakis(trimethylphosphine)tantalum (III). Luetkens, M.L.; Hopkins, M.D.; Schultz, A.J.; Williams, J.M.; Fair, C.K.; Ross, F.K.; Huffman, J.C.; Sattelberger, A.P. (Univ. of Michigan, Ann Arbor). *Inorganic Chemistry;* **26**: No. 15, 2430-2436(29 Jul 1987). Contract W-31-109-ENG-38.

Dichlorodihydridotetrakis(trimethylphosphine)tantalum(IV), $TaCl_2H_2(PMe_3)_4$, is reduced under argon by sodium amalgam in the presence of PMe_3 to give green $TaClH_2(PMe_3)_4$ (1a) in 70% yield. 1a has been characterized by spectroscopy, variable-temperature ^1H and $^{31}P\{^1H\}$ NMR spectroscopy, and low-temperature (50K) neutron crystallography. In the solid state, 1a is a slightly distorted pentagonal bipyramid with two axial phosphines. The hydride ligands are coordinated in a cis configuration in the pentagonal plane with a H-Ta-H angle of 66.2 (6)° and Ta-H distances of 1.79 (1) and 1.80 (1) A. 1a reacts readily with $Me_2PCH_2CH_2PMe_2$ (dmpe) to give $TaClH_2(dmpe)_2$ (2) and with ethylene to give $TaCL(C_2H_4)(PMe_3)_4$ (3). It also reacts with dinitrogen to given the μ-dinitrogen complex $[TaClH_2(PMe_3)_2]_2(\mu\text{-}N_2)$ (4a) and with carbon monoxide to provide $TaCl(CO)_3(PMe_3)_2$ (5). The latter complex has been characterized by low-temperature (-160°C) X-ray crystallography. In the solid state, 5 is a capped (by Cl) trigonal prism with three PMe_3 ligands and one CO on the capped quadrilateral face and two CO ligands on the remaining edge. Crystal data for 1a (at 50 K) and for 5 are presented. 25 references, 5 figures, 6 tables.

18787 X-ray absorption spectroscopic evidence for a unique nickel site in Clostridium thermoaceticum carbon monoxide dehydrogenase. Cramer, S.P.; Eidsness, M.K.; Pan, W.H.; Morton, T.A.; Ragsdale, S.W.; DerVartanian, D.V.; Ljungdahl, L.G.; Scott, R.A. (Exxon Research and Engineering Company, Annadale, NJ). *Inorganic Chemistry;* **26**: No. 15, 2477-2479(29 Jul 1987). Contract AS09-79ER10499.

Carbon monoxide dehydrogenase (COdH) in Clostridium thermoaceticum is an $\alpha_3\beta_3$ protein containing six nickels per molecule, in addition to a number of Fe-S clusters. Previous electron paramagnetic resonance (EPR) spectroscopic work has suggested that nickel is involved in binding CO forming an EPR-detectable species, which is probably a key intermediate in the oxidation of CO to CO_2 and in the synthesis of acetate. In order to better define the nature of this nickel site, Ni X-ray absorption spectra have been recorded and interpreted by comparison with model compounds. The extended X-ray absorption fine structure (EXAFS) spectrum for oxidized COdH is different from that of other Ni enzymes. Both the EXAFS and the X-ray absorption edge spectra suggest a Ni site containing substantial sulfur ligation. The Ni X-ray absorption edge spectrum of rubredoxin-oxidized COdH exhibits a characteristic shoulder with an inflection point at 8336 eV. Such a feature is absent in octahedral model compounds, whereas a well-resolved peak is observed in square-planar Ni complexes. A distinct $1s \rightarrow 3d$ transition at 8333 eV is observed in a tetrahedral model. The lack of correspondence suggests that square-pyramidal and distorted-square-planar geometries are plausible candidates for the COdH Ni site. Treatment of rubredoxin-oxidized COdH with hydrogenase and H_2 shifts the Ni edge to lower energies, indicating Ni-based reduction. 34 references, 3 figures.

18788 Mode of coordination of tris(2-pyridyl)methanol to ruthenium(II): synthetic, spectral, and structural studies of the bis(ligand) species. Keene, F.R.; Szalda, D.J.; Wilson, T.A. (James Cook Univ. of North Queensland, Townsville, Australia). *Inorganic Chemistry;* **26**: No. 14, 2211-2216(15 Jul 1987). Contract AC02-76CH00016.

Two forms of the cation bis[tris(2-pyridyl)methanol]ruthenium(II) have been isolated--a yellow species, $[Ru((py)_3COH)_2]^{2+}$ (2), and an orange form in which one ligand is deprotonated, $[Ru((py)_3COH)((py)_3CO^-)]^+$ (1). The pK/sub a/ for the ligand deprotonation is 3.78 (+/-0.02) in aqueous 0.1 M KNO_3 at 25.0°C. X-ray structural determinations show coordination occurs in an (N,N',-N'')(N,N',O) mode for both complexes, with the coordinated oxygen atom being the site of the acid/base reactivity. The deprotonated species (1) has a plane of symmetry with Ru-N bond lengths in the range 2.040-2.063 A. The nondepro-

tonated form (2) has Ru-N bond lengths in the range of 2.046-2.058 A, except for an abnormally short Ru-N bond (2.023 (2) A) trans to the coordinated Ru-OH. Additionally, in 2 the plane of symmetry is lost. In aqueous solution the redox for the Ru(III)/Ru(II) couples are 0.40 (2) and 0.25 V (1) vs. SSCE. The electronic and ^{13}C NMR spectra are also reported. Crystal parameters for both the protonated and deprotonated form of the named complex are reported. 39 references, 3 figures, 4 tables.

18789 Solubility of amorphous chromium(III)-iron(III) hydroxide solid solutions. Sass, B.M.; Rai, D. (Battelle, Pacific Northwest Labs., Richland, WA). *Inorganic Chemistry;* **26**: No. 14, 2228-2232(15 Jul 1987).

Neutralization of acidic solutions containing Cr(III) and Fe(III) at room temperatures results in coprecipitation of these elements as an amorphous solid solution [Cr/sub x/Fe/sub 1-x/$(OH)_3$]. The solubilities of the Cr/sub x/Fe/sub 1-x/$(OC)_3$ precipitates prepared with different mole fractions (x) of $Cr(OH)_3$ (0.99, 0.89, 0.69, 0.49, 0.36, 0.15, 0.09, 0.01, 0.00) were determined in 0.01 M prechlorate solutions between pH 2 and 6 in an N_2 atmosphere. The Cr concentrations in 0.0018-μm filtrates at various times between 5 and 210 days, from initially undersaturated and oversaturated solutions, show that equilibrium was attained within about 7 days when $x < 0.5$ and more slowly when higher mole fractions of $Cr(OH)_3$ were used. In general, aqueous Cr concentrations decrease with decreasing Cr contents in the solids, suggesting that Cr/sub x/Fe/sub 1-x/$(OH)_3$ behaves thermodynamically like a solid solution. Activity coefficients for $Cr(OH)_3$ in the solid solutions were calculated from the solubility data and are given by the equation log λ/sub Cr(OH)3/ = $-1.60 + 0.28(1 - x)^2 - 1.79(1 - x)^3$ for $0.01 \leqq x \leqq 0.69$. Aqueous Fe activities were generally too low for reliable measurement; therefore, the corresponding activity coefficients for $Fe(OH)_3$ [log λ/sub Fe(OH)3/ = $-2.26x^2 + 1.39x^3$] were calculated by a Gibbs-Duhem equation. A general relationship [log $(CrOH^{2+})$ = $-2pH + 4.18 + 0.28(1 - x)^2 - 1.79(1 - x)^3 + \log x$] developed from these data can be used to calculate Cr concentrations in solutions between pH 2 and 6 that are in equilibrium with Cr-bearing ferric hydroxides with known Cr content. 12 references, 6 figures, 1 table.

18790 Computer-simulated images of platinum clusters in the channels of Y zeolites: zone-axis results. Chan, I.Y.; Csencsits, R.; O'Keefe, M.A.; Gronsky, R. (Chevron Research Co., Richmond, CA). *Journal of Catalysis;* **103**: No. 2, 466-473(Feb 1987). Contract AC03-76SF00098.

Computer image simulation has been used to investigate the visibility of a 13-atom Pt cluster in the Y zeolite channel in high-resolution electron microscopy (HREM) images. This study concentrates on the effects of specimen thickness, focusing, and location of the Pt cluster. The results show that the Pt cluster is invisible if the specimen is thicker than 300 A. Even when the specimen is thinner, the appearance of the HREM images can be very deceptive. The practical aspects of studying small particles using HREM are discussed. 11 references.

18791 Effect of surface composition on the chemisorption of hydrogen on tungsten carbide. Boudart, M.; Lee, J.S.; Imura, K.; Yoshida, S. (Stanford Univ., CA). *Journal of Catalysis;* **103**: No. 1, 30-36(Jan 1987). Contract AS03-79ER10502.

Polymeric carbon and oxygen were detected at the surface of tungsten carbide powders by Auger electron spectroscopy and electron spin resonance. Chemisorption of dihydrogen is suppressed by polymeric carbon but enhanced by surface oxygen as some of the latter reacts in the presence of water with hydrogen spilling over from the tungsten carbide parts of the surface. 21 references.

18792 Determination of the distribution of species in supported metal catalysts by X-ray photoelectron spectroscopy. Stranick, M.A.; Houalla, M.; Hercules, D.M. (Univ. of Pittsburgh, PA). *Journal of Catalysis;* **103**: No. 1, 151-159(Jan 1987). Contract AC02-79ER10485.

A method is described for the use of X-ray photoelectron spectroscopy (ESCA) for quantitatively determining the distribution of species in supported metal catalysts. The method can determine the distribution of metal species for catalysts which contain both discrete metal oxide and metal surface phases with differing dispersions. The utility of the method is illustrated for a series of Co/Al_2O_3 catalysts containing Co_3O_4 and both tetrahedrally and octahedrally coordinated Co^{2+} surface phases. The determination of the distribution of Co species for a series of Co/Al_2O_3 catalysts by the present method is consistent with results from studies using other techniques. 23 references.

18793 Surface structure sensitivity of alloy catalysis: catalytic conversion of n-hexane over Au-Pt(111) and Au-Pt(100) alloy crystal surfaces. Yeates, R.C.; Somorjai, G.A. (Lawrence Berkeley Lab., CA). *Journal of Catalysis;* **103**: No. 1, 208-212(Jan 1987). Contract AC03-76SF00098.

Alloys have become important catalysts for many chemical processes due to their superior properties over single component catalysts. These include increased reaction selectivity and greater resistance to deactivation. The reasons for their superior performance are not well understood, however. Catalytic studies, using single component metal single crystal catalysts, coupled with the use of surface science techniques, have proven useful in understanding the nature of the working catalyst. Extension of these investigations to alloy single crystal at high pressures should be useful for elucidating the role of alloying in altering catalytic behavior. In this note the authors report the surface structure sensitivity of the catalytic properties of platinum-gold alloys in the conversion reaction of n-hexane and present evidence for a mixed Au-Pt site on the (111) surface for the isomerization reaction. Experiments were carried out in an ultrahigh vacuum system equipped with Auger electron spectroscopy (AES), low energy electron diffraction (LEED) optics, a quadrupole mass spectrometer, and a sample isolation cell which was connected to the reactor loop and gas chromatograph equipped with a flame ionization detector. 11 references.

18794 I. Generation and mechanistic study of t-butyl exo-methylene-substituted 2,3-dimethylene-2,3-dihydrofurans and a thiophene analogue. II. Generation and study of the dimerization of alkyl ring-substituted 2,3-dimethylene-2,3-dihydrofurans. III. Diels-alder reaction of 2,3-dimethylene-2,3-dihydrofuran and o-xylylene. IV. Formation of the 2,5-dimethylene-2,5-dihydrothiophene trimer and its synthetic application. Huang, Y.J. Ames, IA; Iowa State Univ. (1987). 159p. University Microfilms Order No. 87-16,777.Contract W-7405-ENG-82.

Thesis (Ph. D.).

In Section I, the generation and a mechanistic study of t-butyl exo-methylene-substituted 2,3-dimethylene-2,3-dihydrofurans and a thiophene analogue are reported. The results not only unambiguously support the previous proposed two-step mechanism for the dimerization of 2,3-dimethylene-2,3-dihydrofuran (1), they also provide them with two of the most unreactive o-quinodimethanes, namely, 2-methylene-3-t-butylmethylene-2,3-dihydrofuran (2), and 2,3-di-t-butylmethylene-2,3-dihydrofuran. In Section II, the preparation and the dimerization of a series of alkyl ring-substituted and carbomethoxy ring-substituted derivatives of 1 are presented. This study concludes that bulky alkyl substituents on the ring of furan monomers do not promote the [4 + 2] dimerization process. In Section III, a Diels-Alder reaction of 1 and its two deuterated analogues with methyl acrylate reveals the presence of a secondary deuterium isotope effect which strongly supports a stepwise mechanism. This conclusion is further strengthened by the fact that the Diels-Alder reaction of 1 with cis dienophiles proceeds non-stereospecifically. A comparison study of o-xylylene with dienophiles reaches the same conclusion. In Section IV, a convenient synthesis of cyclooctadecane from the thiophene trimer of 2,5-dimethylene-2,5-dihydrothiophene is described. This synthesis offers an efficient alternative to existing routes.

18795 Synthesis and characterization of several cesium zirconates and a study of their relevance to fission-product chemistry. Chen, T.M. Ames, IA; Iowa State Univ. (1987). 112p. University Microfilms Order No. 87-16,750.Contract W-7405-ENG-82.

Thesis (Ph. D.).

Investigations of the reaction of CsI with excess ZrO_2 in various containers at 400-850°C have successfully demonstrated the formation of ZrI_4 and Cs_2ZrO_3 in low yields (< 35%) based upon the analytical evidence from X-ray fluorescence and atomic absorp-

tion techniques. To further investigate the chemistry, macroscopic amounts of the cesium zirconates have been synthesized from reactions of Cs-Zr-O_2 in silver crucibles or of Cs-CsO_2-ZrO_2 and CsO_2-Zr in welded silver tubing at 600-750°C for one to two weeks. These reactions have produced four new compounds: Cs_2ZrO_3 and Cs_4ZrO_4 each in 95-100% yield, and two evidently ZrO_2-richer cesium zirconates of unknown composition and structure in 40-50% yield. The crystal structures of the first two phases have been solved by single crystal methods, and the crystal structures are reported. The thermal stabilities of Cs_2ZrO_3 and Cs_4ZrO_4 have been investigated both in vacuo and in sealed silver containers. The compounds Cs_2ZrO_3 and Cs_4ZrO_4 decompose into Cs_2O and ZrO_2 or Cs_2ZrO_3 at near 915°C and 260-280°C under high vacuum, whereas in sealed silver containers they are stable to above 900°C and to 730 +/- 20°C, respectively. The relevance of the formation and properties of these zirconates to the distribution of fission products is also discussed.

18796 Acidic properties of binary oxide catalysts. II. Moessbauer spectroscopy and pyridine adsorption for iron supported on magnesia, alumina, and titania. Connell, G.; Dumesic, J.A. (Univ. of Wisconsin, Madison). *Journal of Catalysis;* **102**: No. 1, 216-233(Nov 1986). Contract FG02-84ER13183.

The acidic properties of MgO, Al_2O_3, and TiO_2 were studied using pyridine adsorption. Infrared spectroscopy and gravimetric adsorption measurements indicate no acid sites on MgO, while Lewis acid sites were observed on the surfaces of Al_2O_3 and TiO_2. Doping Fe onto MgO and Al_2O_3 was shown by Moessbauer spectroscopy to produce only highly coordinated Fe (e.g., sixfold coordination). A small amount of low coordination iron (e.g., fourfold coordination) was observed on TiO_2. Pyridine adsorption measurements showed that addition of Fe on MgO did not generate acidity, whereas iron produced a small number of sites on Al_2O_3 and iron addition caused a selective poisoning and strengthening of the acid sites on TiO_2. All acids in this series of single component and binary component oxides were Lewis acids. A model of Lewis acidity is proposed in that the existence of coordinatively unsaturated cations responsible for the acidic properties can be predicted using Pauling's electrostatic bond strength rules. This model is also shown to be valid for iron cations deposited on SiO_2.

18797 Direct measurements of heats of adsorption on platinum catalysts. III. Potential errors with differential scanning calorimeters. Sen, B.; Chou, P.; Vannice, M.A. (Pennsylvania State Univ., University Park). *Journal of Catalysis;* **101**: No. 2, 517-521(Oct 1986). Contract FG02-84ER13276.

In a recent paper, the authors reported integral heats of adsorption for H_2 adsorbed on Pt dispersed on a variety of oxide supports. These values were obtained using a modified commercial differential scanning calorimeter (DSC) operated in the isothermal mode. Although the values obtained were very reproducible and fell within the wide spectrum of heats of adsorption reported in the literature, the authors served that the integral Q/sub ad/ values were higher than anticipated compared to the initial heats of adsorption measured in UHV systems. In a subsequent study of H_2 adsorption on Pd, relatively high apparent Q/sub ad/ values were again observed; however, in this system the authors had an internal calibration standard that could be utilized. When this apparent value was also found to be far too high when Ar was used as a carrier gas, it become apparent that an artifact existed which was producing erroneous energy change values. Further experiments showed that this problem was related to changes in the thermal conductivity of the gas in the sample cavity relative to the reference cavity, and it was especially severe with H_2 because of the large difference in thermal conductivity compared to Ar. Therefore, the authors undertook a study to clarify this problem so that others can avoid it in their studies and to develop a set of operating conditions which allow accurate heats of adsorption to be measured. In this paper the authors report corrected heats of adsorption for H_2 on the same family of Pt catalysts. 22 references.

18798 Structural effects in electrocatalysis: oxidation of ethylene glycol on single crystal gold electrodes in alkaline solutions. Adzic, R.R.; Avramov-Ivic, M. (ICTM and Center for Multidisciplinary Studies, Belgrade, Yugoslavia). *Journal of Catalysis;* **101**: No. 2, 532-535(Oct 1986).

Ethylene glycol is a potential fuel of practical interest whose electrooxidation has not been studied in detail. This is a complex reaction whose mechanism is far from being understood. It is quite clear, however, that some kind of strongly bound intermediate is formed in the oxidation of ethylene glycol on platinum. This is indicated also by the effects of foreign metal adatoms covering a part of the Pt surface. Thus, pronounced catalytic effects of Pb, Tl and Bi have been observed in alkaline solutions and these are partly based on a suppression of formation and/or adsorption of strongly bound intermediates. In this work the oxidation of ethylene glycol on gold single crystals with the (100), (110) and (111) orientations has been studied with the aim of investigating whether there is structural sensitivity in this reaction. Structural sensitivity, as well as the role of AuOH species formed on surfaces, could be of interest for both electrocatalysis and catalysis. 13 references.

18799 Hydrogenation of (+)-apopinene over Pd-Si and Pd-Ge glasses. Molnar, A.; Smith, G.V.; Bartok, M. (Southern Illinois Univ., Carbondale). *Journal of Catalysis;* **101**: No. 2, 540-544(Oct 1986). Contract AC02-81ER10897.

Metallic glasses are new materials which present the possibility of preparing new catalysts. From this point of view the authors have been studying the catalytic properties of glassy palladium alloys. The approach has been to employ the molecular probe, (+)-apopinene, which is sensitive to catalytic sites of differing surface coordination. In this present study the authors have examined a number of palladium materials, including splat cooled pure Pd as well as both glassy and crystalline Pd-Si and Pd-Ge prepared by both the shock tube and hammer-and-anvil techniques using the molecular probe (+)-apopinene. Because these materials produce much lower isomerizations than most Pd catalysts, a Pt foil is included as an example of a very low isomerization catalyst. These results can be compared to those obtained over a spectrum of supported and unsupported palladium catalysts for which percentages of exposed Pd atoms are available. 34 references.

18800 Comparative kinetic studies of CO-O_2 and CO-NO reactions over single crystal and supported rhodium catalysts. Oh, S.H.; Fisher, G.B.; Carpenter, J.E.; Goodman, D.W. (General Motors Research Labs., Warren, MI). *Journal of Catalysis;* **100**: No. 2, 360-376(Aug 1986).

The kinetics of the CO-O_2 and CO-NO reactions over single crystal Rh(111) and over alumina-supported Rh catalysts have been compared at realistic reactant pressures. For the CO-O_2 reaction, there is excellent agreement between both the specific rates and activation energies measured for the two types of Rh catalysts. The CO-NO reaction, on the other hand, exhibits substantially different activation energies and specific reaction rates between the single crystal and supported catalysts. This indicates that the kinetics of the CO-NO reaction, unlike the CO-O_2 reaction kinetics, are sensitive to changes in catalyst surface characteristics. The kinetic data for the CO-O_2 and CO-NO reactions over Rh(111) and Rh/Al_2O_3 were analyzed using mathematical models which account for the individual elementary reaction steps established from surface chemistry studies of the interactions of CO, NO, and O_2 with Rh surfaces. The model, when used with the parameter values similar to those reported in the surface chemistry literature, can quantitatively fit the CO oxidation rate data over both the single crystal and supported Rh catalysts. The kinetics of the CO-NO reaction over Rh(111) can also be well described by a reaction model using parameter values taken from surface chemistry studies. However, the rate data for the CO-NO reaction over supported Rh can be rationalized by assuming that the dissociation of molecularly adsorbed NO occurs much more slowly on supported Rh than on Rh(111). 52 references.

18301 Cyclohexane dehydrogenation over a strained-layer Cu/Ru catalyst. Peden, C.H.F.; Goodman, D.W. (Sandia National Labs., Albuquerque, NM). *Journal of Catalysis;* **100**: No. 2, 520-522(Aug 1986). Contract AC04-76DP00789.

The present studies are part of a continuing effort to identify those properties of a bimetallic system which can be related to its special catalytic properties. The specific model system of Cu and Ru was chosen due to the immiscibility of these two metals as well as the pivotal role played by this metal pair in historical bimetallic

studies. The immiscibility of these two metals facilitates coverage determination by temperature-programmed desorption (TPD) and circumvents the many complications associated with the assay of alloy surface composition. The results are discussed from previous studies which have addressed the geometric and electronic structure of Cu overlayers on Ru(0001), the adsorption of CO and H_2 on submonolayer-to-multilayer deposits of Cu, as well as the measurement of the high-pressure kinetics of the methanation and ethane hydrogenolysis reactions on this model bimetallic catalyst. These results suggest that Ru specific rates for methanation and ethane hydrogenolysis on supported Cu/Ru catalysts approximate those values found for pure Ru. As a consequence, the rates for the cyclohexane dehydrogenation reaction on supported Cu/Ru, similarly corrected, must exceed those specific rates found for pure Ru. (The uncorrected specific rates for the supported Cu/Ru system remain essentially unchanged upon addition of Cu to Ru.) An activity enhancement for cyclohexane dehydrogenation in the mixed Cu/Ru system relative to pure Ru is most surprising given that Cu is less active for this reaction than Ru. In this note, the authors report just such an activity enhancement for the addition of Cu to a model Ru(0001) catalyst. 16 references.

18802 **Weakly bound hydrogen on oxygen modified Ru(001) surface.** Hrbek, J. (Brookhaven National Lab., Upton, NY). *Journal of Catalysis;* **100**: No. 2, 523-525(Aug 1986). Contract AC02-76CH00016.

The nature of weakly bound hydrogen on metal surfaces is not fully understood and the experimental data are interpreted as being due to (1) physisorbed hydrogen, (2) chemisorbed molecular hydrogen, (3) dissociatively chemisorbed hydrogen, or (4) hydrogen chemisorbed at surface and subsurface pair sites. In this note the author reports briefly on the formation of new adsorption states of weakly bound hydrogen which are observed on an oxygen modified Ru(001) surface. The low-temperature sites are populated by dissociatively chemisorbed hydrogen: weakly bound hydrogen is the majority species and its desorption spectra resemble those of Pd(110) surfaces. The experimental system and preparation of sample were described in detail elsewhere. The ruthenium surface was cleaned by a combination of Ar^+ sputtering and thermal cycling with adsorbed oxygen. The results of hydrogen adsorption on a clean Ru surface were in good agreement with published data. 26 references.

18803 **Effects of potassium and calcination pretreatment on the adsorption and chemical/physical properties of Fe/SiO_2.** Rankin, J.L.; Bartholomew, C.H. (Brigham Young Univ., Provo, UT). *Journal of Catalysis;* **100**: No. 2, 533-540(Aug 1986). Contract AC22-79ET14809.

Studies of the effects of potassium on CO, CO_2, and hydrogen adsorptions on iron indicate that potassium promotion increases heats of adsorption of CO and H_2, enhances the rate of CO dissociation, increases CO saturation coverage, and decreases the CO sticking coefficient. The purpose of this work was to investigate the effects of potassium promoter and calcination of the stoichiometries and kinetics of CO, CO_2, and H_2 adsorptions on Fe/SiO_2 and to relate these effects to changes in the physical and chemical properties of the catalyst. The results reveal important differences in behavior for CO and H_2 adsorptions on precalcined Fe/SiO_2 and Fe/K/SiO_2 compared to the adsorptions on single crystal or polycrystalline iron, which may relate to changes in the surface and bulk properties of iron such as potassium coverage and extent of reduction. 33 references.

18804 **(ORNL/tr—88/1) Study of hydrolysis and complexing of uranyl ions in sulfate solutions at elevated temperatures.** Nikolaeva, N.M. Translated from *Izvestiya Sibirskogo Otdeleniya Akademii Nauk SSSR, Seriya Khimicheskikh Nauk ;* 7: No. 3, 61-67(1971). Contract AC05-84OR21400. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005324/JAW.

A study was made of uranyl ion hydrolysis at elevated temperatures in the absence of complex formation in dilute nitrate solutions by measuring the pH. It was found that hydrolysis in the temperature range from 50 to 150°C and a total U(VI) concentration of 10^{-2} to 10^{-5} M occurs basically by the three reactions. The data was processed by computer to calculate the equilibrium constants of these reactions and to obtain equations for these constants as functions of temperature. Taking into account hydrolysis, the pH measurements for the uranyl sulfate solutions were used to calculate the equilibrium constants of the dissociation reaction of the sulfate complex. The dissociation constants as functions of temperature were also found. 22 refs., 3 tabs.

18805 **Simple, efficient synthesis of 3′-D/sub 3/-mevalonic acid.** Hawkins, D.R.; Calvin, M. (California Univ., Berkeley, USA. Dept. of Chemistry; Lawrence Berkeley Lab., CA, USA). *Journal of Labelled Compounds and Radiopharmaceuticals;* **24**: No. 10, 1229-1233(Oct 1987).

3′-D/sub 3/-Mevalonic acid was required to study triterpenoid biosynthesis. It was synthesized by a simple route in a 24% yield from D/sub 3/acetic acid-D. The product was characterized as the crystalline salt: N,N′-dibenzylethylenediammonium bis-(3,5-dihydroxy-3-(D/sub 3/-methyl)-pentanoate) and was shown by mass spectroscopy and /sup 1/H-NMR to be essentially 100 atom% deuterium labelled.

4004 Electrochemistry

REFER ALSO TO CITATION(S) 18329, 18331, 18566, 18687, 18903, 19578

18806 **(DOE/PC/90519—T4) Electrochemical characterization and derivatization of coal: Technical progress report, September 15, 1987-December 14, 1987.** Park, Su-Moon. (New Mexico Univ., Albuquerque (USA). Dept. of Chemistry). 1987. Contract FG22-86PC90519. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004450/JAW.

During the course of the electrochemical oxidation of subbituminous coal slurries, we found that electrolysis itself may not facilitate the production of humic acids. It appears that a strong base plays more important roles than moving electrons around for a higher efficiency of the humic acids production. Therefore, we carried out two major subprojects: extraction of humic acids using a strong base (KOH) and theoretical studies on the current-time as well as current-potential behaviors during the oxidation of coal slurries in acidic medium. The electrolytic oxidation of coal slurries in acidic medium was shown to follow a catalytic mechanism. The oxidation of coal slurries in phosphoric acid seems to follow a catalytic-deactivation mechanism. We therefore carried out theoretical studies on chronoamperometric and polargraphic (voltammetric) responses under these conditions. 4 refs.

18807 **Impedance analysis of poly(vinylferrocene) films: The dependence of diffusional charge transport and exchange current density on polymer oxidation state.** Hunter, T.B.; Tyler, P.S.; Smyrl, W.H.; White, H.S. (Dept. of Chemical Engineering and Materials Science, Univ. of Minnesota, Minneapolis, MN 55455). *Journal of the Electrochemical Society;* **134**: No. 9, 2198-2203(Sep 1987).

The impedance of poly(vinylferrocene) (PVF) films coated on Pt electrodes and immersed in acetonitrile solutions containing 0.1M tetra(n-butylammonium) perchlorate has been examined. Three distinct regions are observed in the complex impedance plots for these films: kinetic control at high frequencies, diffusional control at intermediate frequencies, and charge saturation at low frequencies. The effective diffusion coefficient for charge transport, D/sub CT/, the redox capacitance, C/sub 1/, and the exchange current density, i/sub o/, for the reaction [(PVF)/sup n+/ . nCLO/sub 4//sup -/] + ne/sup -/ ⇌ PVF + nCLO/sub 4//sup -/ , have been measured as a function of the polymer oxidation state.

18808 **Kinetics of the ferrous/ferric electrode reaction in the absence of chloride catalysis.** Hung, N.C.; Nagy, Z. (Argonne National Lab., Divisions of Materials Science and Chemical Technology, Argonne, IL 60439-4837). *Journal of the Electrochemical Society;* **134**: No. 9, 2215(Sep 1987). Contract W-31-109-ENG-38.

The kinetics of the ferrous ferric redox electrode reaction has been investigated by many workers as a simple, uncomplicated charge transfer reaction which seems ideal for testing experimental techniques and charge transfer theories. However, it has only re-

cently been understood that very small traces of chloride can have a considerable effect on the reaction rate. The relation between the chloride content of the solution and the rate constant of the ferrous/ferric reaction on a gold electrode in perchloric acid solutions is confirmed in this work. The chloride effect free apparent standard rate constant is found to be 2.2 x 10/sup -5/ cm s/sup -1/, which is two to three orders of magnitude smaller than the rate constants normally reported for this reaction if the chloride content of the solution is not scrupulously controlled. Measurements were carried out by using two different in situ methods for cleaning the working electrode surface rather than employing extensive solution purification. In the first method the measuring electrode was potentiostated at sufficiently negative potentials to desorb the chloride from the surface followed by a potential step to the equilibrium potential and a pulse measurement of the kinetics. In the second method chloride ions were removed from the surface before and during the kinetic measurement by continuous oxidation of chromous ions added in small concentration to the test solution. Good agreement was found among the rate constants determined by these methods and a reported rate constant determined in ultraclean solution.

18809 **Transient conduction electrons in irradiated insulators.** Crawford, O.H.; Ritchie, R.H. (Health and Safety Research Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 49 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—). Contract AC05-84OR21400.

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

The authors performed calculations of transient conduction electron populations and electrical conductivities induced by irradiation of insulating solids. Production of secondary electrons, their energy exchange with the medium, and their eventual capture or recombination are included. The results are of particular interest in connection with the propagation of intense relativistic electron beams in solids, and the radiation response of solid state devices, but may have a wider application. A goal has been to determine the form of the dependences upon radiation intensity, to enable the extrapolation of experimental results to higher intensities. Calculations showing several distinct regimes of intensity dependence are presented.

4005 Photochemistry

REFER ALSO TO CITATION(S) 17642, 18813, 19260, 19262, 19671

18810 **(DOE/ER/04380—8) Mechanisms of photoinduced electron transfer: Final report, July 1, 1977-September 30, 1987.** Jones, G. II. (Boston Univ., MA (USA). Dept. of Chemistry). Dec 1987. Contract AC02-77ER04380. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004917/JAW.

Work which has been conducted under Department of Energy sponsorship over the past ten years at Boston University is described. A general theme for projects which are summarized involves photochemically induced electron transfer reactions for organic compounds. Early studies in the series were directed to the development of new mechanisms for driving isomerization processes which store light energy as latent heat. Other investigations were devoted to an understanding of the dynamics of charge separation for photoexcited (charge-transfer) complexes or ion-pairs. Recent studies focused on the development of charge relays such as dithioethers and viologen or pyridinium ions, the electron transfer photochemistry of high potential quinones, and the photophysical properties of organic dyes bound to water-soluble polymers. 9 figs.

18811 **Molecular water-oxidation catalyst derived from ruthenium diaqua bis(2,2′-bipyridyl-5,5′-dicarboxylic acid).** Rotzinger, F.P.; Munavalli, S.; Comte, P.; Hurst, J.K.; Gratzel, M.; Pern, F.; Frank, A.J. (Ecole Polytechnique Federale, Lausanne, Switzerland). *Journal of the American Chemical Society;* **109**: No. 22, 6619-6626(28 Oct 1987). Contract AC02-83CH10093;AC06-83ER13111.

Controlled-potential electrolysis of cis-Ru/sup II/$L_2(OH_2)_2^{2+}$ (where L is 2,2′-bipyridyl-5,5′-dicarboxylic acid) in 0.5 M H_2SO_4 solutions leads to the formation of a relatively durable and active molecular water-oxidation catalyst. Detailed analyses by UV-visible absorption spectrophotometry, resonance Raman spectrophotometry, electrochemical measurements, HPLC, and elemental analysis indicate that the water-oxidation catalyst is an oxo-bridged dimer, $L_2(H_2O)Ru\text{-}O\text{-}Ru(OH_2)L_2$. The synthesis, spectrophotometric, and redox properties of the monomeric and dimeric ruthenium complexes have been characterized. The effectiveness of the oxo-bridged complex as a water-oxidation catalyst has been evaluated by electrochemical and spectrophotometric analyses and by determination of oxygen production. This newly discovered homogeneous catalyst is highly effective in mediating the thermal and visible-light-induced generation of oxygen from water. A comparison is made between the monomer and dimer and various analogues of the complexes. The presence of the COOH groups at the 5,5′ positions of the bipyridyl ligands correlates with the unusual and favorable properties of cis-$RuL_2(OH_2)_2$ and $L_2(OH_2)Ru\text{-}O\text{-}Ru(OH_2)L_2$. Dimeric ruthenium complexes of similar structure are also formed during the thermolysis and photolysis of Ru(II) tris(2,2′-bipyridyl-5,5′-dicarboxylic acid), RuL_3^{2+}, in 0.5 M H_2SO_4 solutions containing peroxodisulfate.

18812 **Photoinduced charge separation and recombination kinetics in a dimeric iridium(I) complex with covalently bound alkylpyridinium acceptors.** Fox, L.S.; Marshall, J.L.; Gray, H.B.; Winkler, J.R. (California Institute of Technology, Pasadena). *Journal of the American Chemical Society;* **109**: No. 22, 6901-6902(28 Oct 1987). Contract AC02-76CH00016.

In the ideal photochemical energy storage system a photoinduced charge separation must be generated rapidly with minimum energy loss and be maintained by virtue of inefficient electron-hole recombination. These rigorous requirements necessitate a thorough understanding of the diverse parameters that determine the barriers to electron-transfer reactions: free energy changes; donor-acceptor separation, orientation, and electron coupling; inner-sphere reorganization energy; and solvent reorganization energy and dynamics. Clearly, in order to elucidate the contributions of these parameters to electron-transfer barriers, model electron-transfer systems must be prepared which can be selectively modified to vary one or more of these parameters. An important requirement for such systems is the covalent coupling of donor and acceptor into one molecule to surpass diffusional limits and permit study of extremely fast intramolecular electron-transfer reactions. They report here results from a prototypal synthetic donor-acceptor system which exhibits photoinduced electron-transfer rate constants in the vicinity of $10^{12}\ s^{-1}$ at driving forces of ca. 1 eV and charge-recombination rates slower than $2 \times 10^{10}\ s^{-1}$.

4006 Radiation Chemistry

REFER ALSO TO CITATION(S) 18725, 19571, 19578, 19580, 19584, 19590, 19620, 19729, 19927

18813 **(DOE/ER/00038—3066) [Multiprogram Radiation Laboratory primarily involved in radiation chemistry studies]: Quarterly report, October 1, 1987-December 31, 1987.** (Notre Dame Univ., IN (USA). Radiation Lab.). 22 Jan 1988. Contract AC02-76ER00038. 42p. (NDRL—3066). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005616/JAW.

Sixty short reports are given of topics studied in radiation chemistry, photochemistry, and related fields. (DLC)

18814 **(DOE/ER/13227—4) Pulsed laser photothermal spectroscopy of liquids and solids: Progress report for period September 30, 1986-November 30, 1987.** Eyring, E.M. (Utah Univ., Salt Lake City (USA)). Nov 1987. Contract FG02-84ER13227. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003839/JAW.

A new apparatus has been created that measures the lifetimes of radiationless decay processes in liquids on time scales dropping down to a few nanoseconds. The particular novelty of the in-

strument lies in its capability of accurately resolving the shape of pulsed laser generated photoacoustic signals in liquids thus permitting a detailed comparison with recently developed theoretical models for their shape. The use of poly(vinylidene difluoride) piezoelectric detectors in these experiments has been compared with photothermal beam deflection. The measurements have also been extended to the millisecond time scale by the inclusion of photothermal lens detection. A new study of luminescenie in rare earth salts with a variety of inorganic dopants has also been carried out. 9 refs., 6 figs.

18815 (IA—1427, pp 133-134) **Photosensitized hydrogen generation from water mediated by platinum-coated semiconductor particles dispersed in poly-n-methylol-acrylamide colloids.** Rafaeloff, R.; Haruvy, Y.; Baruch, G. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18816 **A comparison of the differential effects of the radioprotectors WR1065 and WR151326 on V79-cell progression.** Treacy, S.; Guilford, W.; Sigdestad, C.P.; Angerman, J.M.; Grdina, D.J. (Argonne National Lab., Argonne, IL 60439). pp 97 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—). Contract W-31-109-ENG-38.

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

The authors characterized the effect of two radioprotector compounds, WR1065 and WR151326, on cell-cycle progression. Each protector was administered at a concentration of 4 mM to exponentially growing cultures of V79 cells for periods of time up to 3 h; under these conditions, no cell toxicity was observed. The c.v. of the G/sub 1/ peaks obtained for unperturbed cell samples routinely ranged from 1.5 to 2.5%. During exposure, both radioprotectors effectively perturbed cell-cycle progression, as characterized by a build-up of cells in S and G/sub 2/. After the protectors were removed, cells began to redistribute throughout the cell cycle; 12 h were required before cells exposed to WR1065 approached levels commensurate with controls. In contrast, cells treated with WR151326 required about 22 h to redistribute to control levels. These data demonstrate that different thiol-containing radioprotector compounds can differentially affect the progression of exposed cells.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 17873, 19371, 19888

18817 (INIS-mf—10548, pp 3-14) **Hydrogenolysis by tritium as a method of preparation of labelled compounds with high molar activity.** Myasoedov, N.F.; Sidorov, G.V. (AN SSSR, Moscow. Inst. Molekulyarnoj Genetiki). 1982. (In Russian). NTIS (US Sales Only), PC A11/MF A01. Order Number DE87780080/JAW. (CONF-8112124—Pt.2).

From 2. Council for Mutual Economic Assistance (CMEA) member-countries symposium; Leningrad, USSR (8 Dec 1981).

The paper presents a study of liquid-phase catalytic reducing dehalogenation (LCRD) of several 8-bromo-purine and 5-bromo-pyrimidine compounds: nucleosides and nucleotides. The kinetics of the LCRD reaction by a tritium-protium mixture has been investigated, a reaction mechanism is suggested involving a palladium catalyst, and an analytical expression is obtained for the kinetic curves. The molar activity of the dehalogenation products is found to depend on the relation between the kinetic parameters of the tritium-LCRD reaction. To increase the molar activity of the tritium-labelled components of nucleic acids one is recommended to carry out the dehalogenation reaction with low-percentage palladium catalysts. 6 refs.; 3 figs.; 3 tabs.

18818 (INIS-mf—10548, pp 266-270) **Determination of the radiochemical purity of tritium-labelled nucleoside-5′-triphosphates using PEI-cellulose microcolumns.** Sidorov, G.V.; Myasoedov, N.F. (AN SSSR, Moscow. Inst. Molekulyarnoj Genetiki). 1982. (In Russian). NTIS (US Sales Only), PC A11/MF A01. Order Number DE87780080/JAW. (CONF-8112124—Pt.2).

From 2. Council for Mutual Economic Assistance (CMEA) member-countries symposium; Leningrad, USSR (8 Dec 1981).

The radiochemical purity of tritium-labelled nucleoside-5′-triphosphates was analysed by means of a highly sensitive continuous-operation detector of UV absorption and a PEI-cellulose microcolumn (3 mm in diameter, 130 mm long). Analysis was performed with 0.1-0.2 nucleotide optical density units (lambda = 254 nm). Elution was carried out by a NaCl concentration gradient. All nucleotides were separated under identical conditions. The duration of analysis did not exceed 1-2 hrs. 3 figs.; 6 refs.

18819 **(Juel—2156) Hot reactions of /sup 13/N in solid methane at 77 K.** Fiergolla, J.; Nebeling, B.; Roessler, K. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Chemie 1 -Nuklearchemie). Sep 1987. 58p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752260/JAW.

The chemical reactions of recoil-/sup 13/N were studied in solid methane at 77 K. /sup 13/N was generated via the the nuclear reaction /sup 12/C(d,n)/sup 13/N. The radiation dose deliverd by the 8.5 MeV deuterons amounted to D/sup */ = 0.6 eV per target molecule. The products formed by high energy chemical processes (hot chemistry) were analyzed by radio-gaschromatography. /sup 13/NH/sub 3/ with 52% and CH/sub 3//sup 13/NH/sub 2/ with 25% radiochemical yield were found to be the main products. HC/sup 13/N was not formed, but CH/sub 3//sup 13/CN amounts to 4%. For the more complex products carbon chain prolongation is prefered over multiple methylation such as show the yields of 8% for C/sub 2/H/sub 5//sup 13/NH/sub 2/ and 3% (CH/sub 3/)/sub 2//sup 13/NH. (CH/sub 3/)/sub 3/N was not detected. The formation of /sup 13/NH/sub 3/ is due to hydrogen abstraction, that of CH/sub 3//sup 13/NH/sub 2/ due to insertion of NH radical into the C-H bond of CH/sub 4/. Another, however, less probable pathway could be the insertion of /sup 13/N into methane. The methylamine radical may react with another methane molecule via hydrogen transfer to methylamine or attack to CH/sub 4/ to dimethylamine. The /sup 13/N-products were formed with high radiochemical purity and can potentially be applied for the synthesis of /sup 13/N-radiopharmaceuticals. The reactions studied bear also informations on chemical processes in space (e.g. solar wind interactions with comets or interplanetary dust). /sup 13/N-high energy chemical products are, however, of a less exobiological significance then those formed by hot carbon atoms, e.g. in the 'mirror' system /sup 11/C/NH/sub 3/(s).

18820 **(DP-MS—87-96) Evaluation of commercially available decontamination chemicals.** Shurte, E.A.; Rankin, W.N. (Vanderbilt Univ., Nashville, TN (USA); Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC09-76SR00001. 16p. (CONF-880201—7). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005584/JAW.

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

The effectiveness of commercially available decontamination solutions was compared with the effectiveness of 10% oxalic acid in controlled laboratory tests. Type 304L stainless steel and Inconel 625 specimens were used. Contamination was sludge from Savannah River Plant (SRP) high level waste tanks. Measured amounts of contamination were placed on each specimen. They were then heated to bond the contamination to the surface and cleaned according to the manufacturer's directions. The effectiveness of the product was determined by monitoring specimens before and after cleaning. Four of the 16 solutions evaluated removed all the contamination from Type 304L stainless steel. Inconel 625 was more difficult to decontaminate. Further tests are planned with the chemicals that were most effective in this test. 4 refs., 6 tabs.

18821 (GSI—87-67(prepr.)) Hydration enthalpies of Md/sup 3+/ and Lr/sup 3+/. Bruechle, W.; Schaedel, M.; Scherer, U.W.; Kratz, J.V.; Gregorich, K.E.; Lee, D.; Nurmia, M.; Chasteler, R.; Hall, H.; Henderson, R. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt, Germany, F.R.; Mainz Univ., Germany, F.R.. Inst. fuer Kernchemie). (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Mainz Univ. (Germany, F.R.). Inst. fuer Kernchemie; Lawrence Berkeley Lab., CA (USA)). Oct 1987. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752237/JAW.

Lawrencium (3-min /sup 260/Lr) and lighter actinides were produced in the bombardement of a /sup 249/Bk target with /sup 18/O ions and loaded onto a cation exchange column in 0.05 M α-hydroxy-isobutyrate solution at pH = 4.85 together with the radioactive lanthanide tracers /sup 166/Ho, /sup 171/Er, and /sup 171/Tm. In elutions with 0.12 M α-hydroxy-isobutyrate solution (pH = 4.85) trivalent Lr was eluted exactly together with the Er tracer and Md close to Ho. Lr elutes much later than expected based on the known elution positions of the lighter actinides and the expected analogy to the elution positions of the homologous lanthanides. From the measured elution positions, ionic radii were calculated for Lr/sup 3+/ and Md/sup 3+/. Semiempirical models allow the calculation of the heat of hydration from the ionic radii, resulting in ΔH/sub hyd/ ≅ - 3654 kJ/mol for Md/sup 3+/ and ΔH/sub hyd/ ≅ - 3689 kJ/mol for Lr/sup 3+/.

18822 (GSI—87-68(prepr.)) Lawrencium chemistry: No evidence for oxidation states lower than 3+ in aqueous solution. Scherer, U.W.; Kratz, J.V.; Schaedel, M.; Bruechle, W.; Gregorich, K.E.; Henderson, R.A.; Lee, D.; Nurmia, M.; Hoffman, D.C. (Mainz Univ., Germany, F.R.. Inst. fuer Kernchemie; Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt, Germany, F.R.; Lawrence Berkeley Lab., CA, USA). (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Mainz Univ. (Germany, F.R.). Inst. fuer Kernchemie; Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Lawrence Berkeley Lab., CA (USA)). Oct 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752238/JAW.

Lawrencium (3 min /sup 260/Lr), together with other actinides, was produced in the bombardement of a /sup 249/Bk target with /sup 18/O ions. There was no sign of a reduction of Lr/sup 3+/ in dilute hydrochloric acid by V/sup 2+/ or Cr/sup 3+/, although in the same experiments, Md/sup 3+/ was reduced to Md/sup 2+/ (E/sup 0/ = -0.2 V). The resulting limit for the reduction potential of the Lr/sup 3+//Lr/sup 1(2)+/ couple is E/sup 0/ < -0.44 volt.

18823 (JINR-R—6-86-641) Electromigration of carrier-free radioisotopes. Yb(3) complexes in aqueous solutions of oxalic and tartaric acid. Roesch, F.; Chan Kim Khung; Milanov, M.; Lebedev, N.A.; Khalkin, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701504/JAW.

Submitted to the journal J. Chromatogr. .

Direct measurements of the rate of ytterbium ion electromigration were used to obtain dependences of u-bar mobility on concentration of two-charge anions of oxalic and tartaric acids in aqueous solutions with ionic strength 0.01 at 298.1 K. Mathematical processing of experimental data enabled to determine concentration stability constants of oxalate [OX/sup 2-/] and tartrate (tart/sup 2-/) complexes: [Yb(OX)]/sup +/, lgK/sub 1/=5.80; [Yb(OX)/sub 2/]/sup -/, lgK/sub 2/=4.06; [Yb(tart)]/sup +/, lgK/sub 1/4.61. Individual ion mobilities were determined: u/sup 0//sub Y/ /sub b(sup 3+)/=+6.01.10/sup -4/ cm/sup 2/ s/sup -2/ v/sup -1/;; u/sup 0//sub [Yb(OX)](sup +)/=+2,5.10/sup -4/ cm/sup 2/ s/sup -1/ V/sup -1/; u/sup 0//sub [Yb(OX)2](sup -)/=-2,5.10/sup -4/ cm/sup 2/ s/sup -1/ v/sup -1/; u/sup 0//sub [Yb(tart)](sup +)/=+2,3.10/sup -4/ cm/sup 2/ s/sup -1/ v/sup -1/. It is shown that Yb(III) is not hydrolyzed in neutral (2 ≦ pH ≦ 8) solutions. 18 refs.; 4 figs.; 2 tabs.

18824 (JINR-R—6-87-190) Electromigration of carrier-free radionuclides. Neutral iodide and bromide complexes of carrier-free /sup 201/Tl(I) in aqueous solutions. Roesh, F.; Chan Kim Hung; Milanov, M.; Khalkin, V.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701505/JAW.

Submitted to the journal Izotopenpraxis.

Individual ion mobility of /sup 201/Tl(I) u/sup 0/Tl/sup +/=+7.3(3)x10/sup -4/ cm/sup 3/s/sup -1/V/sup -1/ was observed at 298.1(1) K in aqueous solutions of H(K)ClO/sub 4/, 1.5x10/sup -3/ ≦ μ ≦ 0.5 and 0.3 ≦ pH ≦ 6.5. Experimental dependences of /sup 201/Tl(I) overall ion mobilities on concentrations of ligand anions in solutions of perchlorate background electrolytes have been used to calculate stability constants of neutral thallium complexes [TlI] and [TlBr] at 298.1(1) K and μ=0.1. They are 115(25) lxmol/sup -1/ and 5.25(35) lxmol/sup -1/, respectively. 18 refs.; 2 figs.

18825 (JINR-R—12-87-146) Electromigration method in radiochemical investigations. Complexing of rare earth and transplutonium elements with 1,2-diaminocyclohexanetetraacetic acid. Gorski, B.; Zen Zin Par. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701507/JAW.

Submitted to the journal Izotopenpraxis.

Electromigration of Pm, Tb, Y, Am and Cf in solutions of 1,2-diaminocyclohexanetetraacetic acid has been investigated, the stability constants of the complexes were determined. The methods of free-liquid electrophoresis and of electrophoresis on porous medium are compared. The mobility of Pm(3) is determined. 8 refs.; 3 figs.; 2 tabs.

18826 f-Orbital to carbonyl 2π back-bonding: the electronic structures of (eta^5-C_5H_5)$_3$UCO and (eta^5-C_5H_5)$_3$UOC. Bursten, B.E.; Strittmatter, R.J. (Ohio State Univ., Columbus). *Journal of the American Chemical Society;* **109**: No. 22, 6606-6608(28 Oct 1987). Contract FG02-86ER13529.

The electronic structures of Cp_3UCO (1), $[Cp_3UCO]^+$ (1^+), and Cp_3UOC (2) have been investigated by Xα-SW molecular orbital calculations with quasirelativistic corrections. Two major interactions of 1 are discussed. The CO 5σ lone pair interacts primarily with the empty U 6d orbitals to form the U-CO σ bond, and extensive U 5f → CO 2π back-bonding is observed. In 1^+, the σ interaction is not affected by oxidation while the π back-bonding interaction is decreased. In contrast to 1,2 shows no π back-bonding interaction, and the CO 4σ orbital interacts with the filled U 6p orbitals. Upon the basis of these calculations, it is believed that 2 would be unstable relative to 1.

18827 Synthesis and coordination chemistry of (carbamoylmethyl)thiophosphonates. Crystal and molecular structure of cis-dioxodichlorobis[diethyl((diethylcarbamoyl)methyl)thiophosphonate]molybdenum(VI). McCabe, D.J.; Duesler, E.N.; Paine, R.T. (Univ. of New Mexico, Albuquerque). *Inorganic Chemistry;* **26**: No. 14, 2300-2304(15 Jul 1987).

Bifunctional (carbamoylmethyl)thiophosphonates, $(RO)_2P(S)CH_2C(O)NEt_2$ (R = Et, Bu), have been prepared and characterized by elemental analysis and mass, infrared, and NMR spectroscopy. The coordination chemistry of one ligand (R = Et) with molybdenyl, lanthanide, and uranyl ions has been surveyed. cis-Dioxodichlorobis[diethyl((diethylcarbamoyl)methyl)thiophosphonated]molybdenum(VI), $MoO_2Cl_2[(C_7H_5O)_2P(S)CH_2C(O)N(C_2H_5)_2]_2$ has been isolated from the combination of MoO_2Cl_2 and the thiophosphonate ligand in ethanol/ether mixtures. The resulting complex has been characterized by elemental analyses, infrared and ^{31}P and ^{13}C NMR spectroscopy, and single-crystal X-ray diffraction analysis. The crystal parameters are reported. The structure was solved by heavy-atom methods, and blocked least-squares refinements converged at R/sub F/ = 5.6% and R/sub wF/ = 5.9% on 2670 unique reflections with F ≧ 5sigma(F). The structure contains monomeric units of the complex with the six-coordinate Mo atom having a pseudooctohedral co-

ordination geometry. The two (carbamoylmethyl)thiophosphonate ligands are bonded to the Mo atom in a monodentate mode through the carbonyl oxygen atoms. The important bond distances were measured and are reported. 29 references, 1 figure, 3 tables.

18828 **Calorimetric studies of curium complexation. 2. Amino carboxylates.** Choppin, G.R.; Rizkalla, E.N.; Sullivan, J.C. (Florida State Univ., Tallahassee). *Inorganic Chemistry;* **26**: No. 14, 2318-2320(15 Jul 1987).

Calorimetric titrations using the long-lived isotope of curium (curium-248) have been conducted with nitrilotriacetate, trans-1,2-cyclohexanedinitrilotetraacetate, and trimethylenedinitrilotetraacetate. The data plus the stability constants measured previously allowed calculations of the thermodynamic parameters of the 1:1 complexation. Similar titrations were conducted with europium to provide comparison of the lanthanide and actinide trivalent ion behaviors. The enthalpy values for the amino polycarboxylate complexing of Cm(III) are greater than those for Eu(III). However, the entropy values for the complexing of both cations are similar. These results are comparable to the previously reported data for EDTA. 13 references, 2 figures, 3 tables.

18829 **Solubility of NpO/sub 2/.chiH/sub 2/O(am) in the presence of Cu(I)/Cu(II) redox buffer.** Rai, D.; Swanson, J.L.; Ryan, J.L. (Battelle Pacific Northwest Labs., Richland, WA, USA). *Radiochimica Acta;* **42**: No. 1, 35-41(1987). Contract AC06-76RL01830.

Copper(I)/copper(II) redox buffer was tested for suitability in studying NpO/sub 2/.xH/sub 2/O(am) solubility and was found to be stable with time and to equilibrate rapidly with the Np species. The solubility of NpO/sub 2/.xH/sub 2/O(am) was therefore studied in the presence of Cu(I)/Cu(II) buffer (0.001 M CuCl/sub 2/ and CuCl, and 0.01 M NaCl) and in the pH range from 1.5 to 2.5. Adequate concentrations of buffer species (Cu(I) and Cu(II)) ensured that measured redox potentials accurately reflected the equilibrium values. Based on the measured redox potentials, pH, and calculated activities of Np/sup 4+/ and NpO/sub 2//sup +/, the thermodynamic equilibrium constants at room temperature for the Np/sup 4+/ and NpO/sub 2//sup +/ forming dissolution reactions were determined. The experimental log K/sub sp/ values of Th(IV), Np(IV), and Pu(IV) hydrous oxides show a linear relationship with the inverse square of the M/sup 4+/ ionic radii. Therefore, it is possible to reliably estimate the log K/sub sp/ values for other tetravalent actinide hydrous oxides as well. These estimated log K/sub sp/ values are -52.6 for U(IV), -50.6 for Pa(IV), - 58.0 for Am(IV), and -59.1 for Cm(IV) hydrous oxides.

18830 (IA—1427, pp 173-174) **Solid phase iodination of MIBG and IAMP. Two radiopharmaceuticals for adrenal and brain imaging.** Freud, A.; Canfi, A.; Teitelbaum, Z. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18831 (IA—1427, pp 174-175) **Preparation of Belton-Hunter reagent for radioiodination of sensitive materials.** Canfi, A.; Freud, A.; Teitelbaum, Z. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18832 (JINR-R—6-87-252) **Allyl astatide.** Norseev, Yu.V.; Szucs, Z.; Vasaros, L. (Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of Nuclear Problems; 3635420HU). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701506/JAW.

Submitted to the journal Radiokhimiya.

Allyl astatide has been prepared by means of halogen exchange between allyl bromide and astatide ion. Hot halogen replacement reaction by astatine-211 atoms formed by electron capture from /sup 211/Rn was used to obtain allyl astatide. Gas chromatography served to identify the compound formed. Indices of its retaining on some liquid phases were found. The stability of new astatine compound has been studied. The boiling point of allyl astatide has been determined by extrapolation method and was found to be (129+-2) deg 0 C. 9 refs.; 1 tab.

18833 (OEFZS—4411) **Synthesis, radiochromatography and biodistribution of Tc99m-hexakis-(methoxyisonitrile)-technetium(I) complexes.** Angelberger, P.; Zbiral, E. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Inst. fuer Chemie). (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Sep 1987. 12p. (CH—378/87). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701532/JAW.

Following previous experience with Tc-99m-hexakis(t-butylisonitrile)-technetium(I) (Tc99m-tBiN) synthetic routes to the new ligands a) 1-methoxypropyl-2-isonitrile (MPiN) and b) 2-methoxy-2-methylpropyl-1-isonitrile(MiBiN) were developed via dehydration of the corresponding formamides. Formamide (a) was prepared from the available amine (a) while formamide (b) was synthesised by a difficult 5 step sequence starting from tert.2,2,2-trichlorobutanol. Product MPiN and MiBiN was purified by vacuum distillation and characterized by elemental analysis, IR- and NMR-spectra. A labeling method was developed based on earlier work with Tc99m-tBiN :the pure isonitrile ligand in ethanolic/aqueous solution was complexed at elevated temperature with reduced Tc-99m formed in situ with dithionite at alkaline pH. The whole reaction mixture was subjected to preparative HPLC leading to identification by UV-absorption and isolation of pure n.c.a. Tc99m-MPiN (A) and Tc99m-MiBiN (B) free of unreacted ligand. Work-up of the isolated peak resulted in an injectable product (overall radiochemical yield ~80% within ~40 min total preparation time) which was further controlled by TLC (radiochemical purity >97%, in vitro stability >6 hrs). Biodistribution in mice compared to identical data obtained with Tc99m-tBiN revealed somewhat higher heart uptake, slightly lower lung but significantly lower liver activity and renders these new Tc99m-compounds highly promising for myocardinal perfusion studies in man. 11 refs., 5 figs.

18834 (ZfK—590, pp 103-105) **SCF-X/sub α/-calculations on the $[TcOS_4]^{1-}$ cluster.** Richter, H. Jun 1986. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE87703048/JAW.

In Annual Report 1985. Radioisotope Department.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 18524, 18723, 18917, 18918

18835 (AD-A—186253/1/XAB) **Analysis of the burning region and plume of a large fire. Technical report, 26 November 1984-26 February 1986.** Small, R.D.; Larson, D.A.; Remetch, D.; Brode, H.L. (Pacific-Sierra Research Corp., Los Angeles, CA (USA)). 30 Sep 1986. 68p. (PSR—1672). NTIS, PC A04/MF A01.

The strongly buoyant flow generated in and around a large area fire is analyzed. Jump conditions applicable at the fire periphery are used to affect model-problem closure, thus permitting calculation of induced fire winds independent of a far-field analysis. Combustion processes are modeled by a volume heat addition. The induced flow is compressible, with arbitrary changes in temperature and density allowed. In one parameter limit, a closed-form solution is developed that concisely describes the basic interchanges of energy and momentum as well as the role of pressure gradients in fire-wind generation. The full analysis is applied in simulation of the hydrothermodynamics of a multiple-fuel-bed Flambeau fire. Computed results duplicate observed flow patterns. A parametric analysis explores the influence of combustion-zone dimensions, heating rate, radiation, and turbulent diffusion on the solution for even larger fires. Next, hydrocode solutions are presented for fires of city size with radii of several kilometers and flame heights of 100 m. The atmospheric response as a function of time is illustrated. Vortex motions generated by the fire influence both the inflow and plume structure. A fairly persistent circulatory flow develops below the tropopause. Periodically, however, the tropopause is

penetrated, and an upper-level counter-rotating flow develops that may contain some combustion products from the central fire region. Results suggest the formation of distinct smoke strata in the lower atmosphere, with some particulate and aerosol mass entering the stratosphere.

18836 **(AD-A—186403/2/XAB) Investigation of fuel-additive effects on sooting flames. Annual report.** Bonczyk, P.A. (United Technologies Research Center, East Hartford, CT (USA)). 30 Jun 1987. 14p. (UTRC/R—87-957464-A). NTIS, PC A03/MF A01.

The objective of this research is to clarify the mechanisms responsible for the suppression of soot in flames by fuel additives. Measurements are limited to well-defined hydrocarbon/air prevaporized liquid- and gaseous-fueled flames. Emphasis is given to ferrocene in a diffusion flame fueled by prevaporized iso-octane. Nonperturbing laser/optical diagnostic techniques are used to relate changes in soot particulate size, number density, and volume fraction to additive concentration. Ferrocene is observed to suppress a visible soot plume completely and, in general, to intervene at a late combustion stage. Suppression is due to both size and number density reduction, which suggests that ferrocene enhances the oxidative burn-out of soot. In contrast, at an early combustion stage nearer the burner lip, a slight enhancement of soot observed with ferrocene seeding.

18837 **(CONF-870737—1-FP) Shock tube studies of pyridine pyrolysis and their relation to soot formation.** Kern, R.D.; Yong, J.N.; Kiefer, J.H.; Shah, J.N. (New Orleans Univ., LA (USA). Dept. of Chemistry; Illinois Univ., Chicago (USA). Dept. of Chemical Engineering). 1987. Contract FG02-85ER13340;FG02-85ER13384. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005048/JAW.

From 16. shock tube symposium; Aachen, F.R. Germany (26 Jul 1987).

Two independent shock tube methods, laser schlieren densitometry and time-of-flight mass spectrometry, were used to investigate the thermal decomposition of pyridine. The decomposition is shown to be a strong chain reaction, probably initiated by C-H scission. From an analysis of the LS initial rate data, a (average) value for the heat of formation of pyridyl of 76 +- 10 kcal/mol is obtained. The low soot yields in this pyrolysis are confirmed and their origin discussed. 25 refs., 6 figs., 1 tab.

18838 **(CONF-8708211—1) The molecular dissociation of vinylacetylene and its implications for acetylene pyrolysis.** Kiefer, J.H.; Mitchell, K.I. (Illinois Univ., Chicago (USA). Dept. of Chemical Engineering). 1987. Contract FG02-85ER13384. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005047/JAW.

From Meeting on advances in soot chemistry; New Orleans, LA, USA (1 Aug 1987).

Laser schlieren-shock tube measurements of the pyrolysis of vinylacetylene (C_4H_4, 1-buten-3-yne) show no trace of chain reaction. These also require a heat of reaction for the dissociation process near 40 kcal/mol, and an RRKM fit to the derived rate constants indicates a barrier of 80 +- 3 kcal/mol. Product distributions from this pyrolysis are strongly dominated by C_2H_2 and C_4H_2, with a remarkably consistent 5-10:1 ratio of C_2H_2 to C_4H_2. This all suggests the dominant dissociation path for vinylacetylene is the molecular process $C_4H_4 \rightarrow 2C_2H_2(\Delta H_{298}° \sim 39$kcal/mol) with about 20% via $C_4H_4 \rightarrow C_4H_2 + H_2$ ($\Delta H_{298}° \sim 42$kcal/mol). Detailed balance rate constants for $2C_2H^2 \rightarrow C_4H_4$ are very close to literature rates for this reaction, confirming vinylacetylene as a major direct product of the homogeneous dimerization of C_2H_2 for low to moderate temperatures. At high temperatures/low pressures this will go over to the direct reaction $2C_2H_2 \rightarrow C_4H_2 + H_2$, and to a much lesser extent $2C_2H_2 \rightarrow C_4H_3 + H$. An inverse vinylidene insertion reaction is proposed as the mechanism for both vinylacetylene molecular dissociation channels. 40 refs., 6 figs.

18839 **(DOE/ER/13384—2) Shock tube studies of high temperature hydrocarbon pyrolysis rates: Progress report, June 1, 1985-December 15, 1987.** Kiefer, J.H. (Illinois Univ., Chicago (USA). Dept. of Chemical Engineering). 1987. Contract FG02-85ER13384. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004807/JAW.

Pyrolysis kinetics for high temperatures in the shock tube of benzene, 1,3-butadiene, ethyl benzene, toluene, cyclohexene, pyridine, and vinylacetylene is presented. A new technique for fast kinetics in shock waves - Pulsed Laser Flash Absorption - has been developed. A description of its application to 1,3-butadiene dissociation has been submitted and is described. Research on the unimolecular dissociation of vinylacetylene has led to the proposal of a new molecular mechanism for the pyrolysis of acetylene. A quantitative application to previous shock-tube data on acetylene pyrolysis is described in detail. The small shock tube for pulsed laser absorption in the vuv is now set up and in operation at Argonne National Lab. Flash absorption records of OH formation at 308.8 nm have been obtained from shock waves in H_2 - O_2 - Ar and CH_3OH - Ar. A purification and mixing system has been developed and its performance characterized. Progress has also been made in the design and construction of optics for the vuv laser system. 15 refs., 12 figs.

42 ENGINEERING

REFER ALSO TO CITATION(S) 19937

18840 **(IA—1427, pp 14-15) On the benefit of a third eye for machine stereo perception.** Gurewitz, E.; Dinstein, I. (Israel Atomic Energy Commission, Tel Aviv; Ben-Gurion Univ. of the Negev, Beersheba, Israel). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18841 **(LA-UR—88-111) Method to evaluate image-recovery algorithms based on task performance.** Hanson, K.M. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 9p. (CONF-880153—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005382/JAW.

From Medical imaging II conference; Newport Beach, CA, USA (31 Jan 1988).

A method for evaluating image-recovery algorithms is presented, which is based on the numerical assessment of how well a specified visual task may be performed using the reconstructed images. A Monte Carlo technique is used to simulate the complete imaging process including the generation of scenes appropriate to the desired application, subsequent data taking, image recovery, and performance of the stated task based on the final image. The use of a pseudo-random simulation process permits one to assess the response of an image-recovery algorithm to many different scenes. Nonlinear algorithms are readily evaluated. The usefulness of this method is demonstrated through a study of the algebraic reconstruction technique (ART), the nonnegativity constraint in ART can dramatically increase the detectability of objects in some instances, especially when the data consist of a limited number of noiseless projections. 9 refs., 5 figs., 1 tab.

18842 **(UCRL—96104) Nonlinear refractive index measurements of glasses and crystals.** Adair, R.; Chase, L.L.; Payne, S.A. (Lawrence Livermore National Lab., CA (USA)). Dec 1987. Contract W-7405-ENG-48. 5p. (CONF-8710273—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005673/JAW.

From International laser science conference; Seattle, WA, USA (20 Oct 1987).

We have measured the nonlinear index for numerous glasses and crystals with the goal of determining the material properties that contribute to the magnitude and dispersion of n_2. We have found that a nearly-degenerate three-wave-mixing (TWM) process is the most useful method since it can provide both rapid and accurate n_2 measurements. 5 refs., 1 fig.

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REFER ALSO TO CITATION(S) 17771, 17782, 18195, 18387, 18404, 18599, 18612, 18963, 19982, 20012, 20384, 20500, 20600

18843 (BDX—613-3878) Comparison of isopropyl alcohol and trichloroethylene in removing solder flux: Topical report. Benkovich, M.G. (Allied-Signal, Inc., Kansas City, MO (USA). Bendix Kansas City Div.). Jan 1988. Contract AC04-76DP00613. 21p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005556/JAW.

This work evaluated a nontoxic solvent for its ability to remove solder flux as compared to trichloroethylene solvent. Isopropyl alcohol was evaluated for its cleaning efficiency for solder flux removal using a high pressure spray process (minimum spray pressure of 80 psig). Cleanliness levels were measured by the Meseran Surface Analyzer. Test samples also underwent gas chromatograph/mass spectrometer Analysis and were visually inspected under a longwave ultraviolet lamp. Detailed analyses of flux removal by the two solvents were made as related to solder flux types, solder flux diluted by 50% with isopropyl alcohol, and solder process conditions. 2 refs., 2 figs., 12 tabs.

18844 (DOE/DP/10579—1) Optimization of parameters affecting LSM performance as diffractors of x rays: Final technical report, 13 May 1986-31 October 1987. Knight, L.V. (Brigham Young Univ., Provo, UT (USA)). Oct 1987. Contract AS08-86DP10579;W-7405-ENG-48. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005809/JAW.

Our efforts during this contract period were directed toward a deeper understanding of several important issues related to multilayer x-ray mirrors. The results have important practical applications. The topics studied included: Basic Stress-Strain-Curvature Theory for Thin Silicon Wafers with Oxide and Nitride Films; this theory and accompanying experimental verification could form the basis for development of a code that will be able to predict the final figure of a silicon substrate that has been etched and treated with oxide or nitride films; this code will allow the design and fabrication of sophisticated curved multilayers; we have applied our theoretical understanding of multilayers to the design of multilayer x-ray optics; Multilayer X-ray Data Analysis Codes; these codes allow the massaging and display of x-ray multilayer characterization data in a wide variety of graphical ways; the code is user friendly; simulation of multilayers behavior in a high x-ray flux environment; this code combines an x-ray input code (BUCKL) with a 1-D hydrodynamic code (Chart-D) and our own iterative multilayer design code to determine the reflectivity of multilayers as a function of time when the multilayer is in a region of high x-ray flux; BUCKL and Chart-D are from Sandia Labs.; and we have completed the first series of experimental measurements of multilayer reflectivity while subjected to a pulse of intense x-ray flux; the experiments were done with the Phoenix laser at LLNL; the results are included. 48 refs., 29 figs.

18845 (DP-MS—87-152) Agency update: Savannah River Plant. Eberhard, B.J. (Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 4p. (CONF-8710203—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003762/JAW.

From IMOG joining subgroup meeting; Kansas City, MO, USA (13 Oct 1987).

This report summarizes activities at the Savannah River Plant, with regard to personnel, program activities, and equipment. Pinch welding procedures are discussed and progress on reclamation of 3T and SP 1030/1031 reservoirs has been detailed Gas Metal Arc welding was also investigated as a means of structural repair of reactor vessels. (FI)

18846 (EGG-M—08887) Modeling of laser ultrasound generation in a weld pool. Johnson, J.A. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 8p. (CONF-870691—9). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005546/JAW.

From Review of progress in quantitative NDE; Williamsburg, VA, USA (21 Jun 1987).

Finite element techniques are used to model laser generation of ultrasound and its propagation through a weld pool. The laser generation is modeled by assuming the reactive force to the laser ablation of the liquid is a stress perpendicular to the surface of the pool. The boundary of the pool is assumed to be spherical. The propagation of the sound waves from the laser source through the boundary into the solid metal is calculated assuming homogeneous properties in both the liquid and solid metal and temperature gradient effects are neglected. The results are compared to a series of experiments on real and simulated weld pools. 6 refs., 6 figs.

18847 (LA—11207-MS) Gas shutter closure for sealing LOS [lines of sight] pipes. Cosimi, R.A. (Los Alamos National Lab., NM (USA)). Feb 1988. Contract W-7405-ENG-36. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005667/JAW.

An extensive effort went into the design and development of an extremely reliable gas shutter closure for use in sealing a line of sight pipe between a nuclear explosion and an experiment array. The type of event that would require a gas shutter has been out of vogue for many years, but recently there has been a renewed interest in vertical line of sight testing. This report documents some of the unwritten history of the valves before this history is completely forgotten. 3 figs.

18848 (RFP—4040) Pumpdown table process control application. Rotherham, W.D. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1986. Contract AC04-76DP03533. 12p. (CONF-8610230—2). NTIS, PC A03. Order Number DE88005143/JAW.

From Rockwell software symposium; Cedar Rapids, IA, USA (6 Oct 1986).

Pumpdown tables are used in the final production phase on nuclear components. The basic concept is to pull a vacuum on the component, while heating it, and then to fill the component with a preselected gas. This process was automated to insure a more uniform product and to generate a point by point record of the operation. This paper discusses this process control further.

18849 (UCID—21289) Thermal stress analysis of an x-ray beam shutter. Kornblum, B.T. (Lawrence Livermore National Lab., CA (USA)). Dec 1987. Contract W-7405-ENG-48. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005501/JAW.

The shutter is a beam absorbing "dump" for the x-ray beam of the Positron Electron Project (PEP) Beamline 5B at the Stanford Synchrotron Radiation Laboratory (SSRL). A narrow x-ray beam hits the copper shutter, which is water cooled for heat removal. The steady-state temperature field and the stress distribution resulting from temperature gradients were calculated using finite element analysis codes. Models in two and three dimensions were studied. An analysis of the thermally induced stresses in the shutter shows that the maximum effective stress is 9700 psi. This value is very near the assumed yield stress of the material, 10,000 psi, and it corresponds to a region on the shutter where the peak temperature of 270°F occurs. 15 refs., 8 figs., 2 tabs.

18850 (UCRL—15980) Robust decentralized control of large flexible structures. Lu, S.C.; Fong, I.K.; Wang, S.H.; Bumpus, S. (Lawrence Livermore National Lab., CA (USA); California Univ., Davis (USA). Dept. of Electrical and Computer Engineering). 17 Nov 1987. Contract W-7405-ENG-48. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005416/JAW.

This report studies the problem of controlling large flexible structure with robust decentralized feedback control. A decentralized optimal control algorithm is applied to compute the parameters of the robust controller. The proposed method is tested on the ACOSS Model No. 2, which is a realistic evaluation model for active structure control methods. Twelve co-located sensors and actuators are applied in order to suppress vibrations which are caused by two external disturbances. It is demonstrated that the proposed method can stabilize the closed-loop system via decentralized feedback. Other performance measures are also discussed. 11 refs., 8 figs.

18851 (UCRL—94020) Defining characteristic times in forced-ventilation enclosure fires. Alvares, N.J.; Foote, K.L.; Pagni, P.J. (Lawrence Livermore National Lab., CA (USA)). Mar 1987. Contract W-7405-ENG-48. 34p. (CONF-8612123—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005473/JAW.

From International symposium on mathematical modeling of fires and related fire test methods; New Orleans, LA, USA (3 Dec 1986).

Several characteristic times have been identified for describing force-ventilated enclosure fires. By using the initial properties of an enclosure and a prescribed fire heat release rate, a set of appropriate times for hazard evaluation can be calculated. Three times are proposed, defined, and tested. These times are characteristic of (1) the histories of the mass of gas in the room, (2) the energy in the room, and (3) the response of the enclosure walls. These parameters are independent indicators of steady state conditions in force-ventilated enclosure fires. 9 refs., 7 figs., 2 tabs.

18852 (UCRL—96204) Electron emission from conductors subjected to intense, short-pulse electric fields. Scarpetti, R.D.; Goerz, D.A.; Bowen, P.R.; Hodgin, R.L.; Wong, K.C.; Champney, P.D'A. (Lawrence Livermore National Lab., CA (USA); Pulse Sciences, Inc., San Leandro, CA (USA)). Jun 1987. Contract W-7405-ENG-48. 6p. (CONF-870656—49). NTIS, PC A02. Order Number DE88005412/JAW.

From 6. Institute of Electrical and Electronic Engineers pulsed power conference; Arlington, VA, USA (29 Jun 1987).

We studied electron emission from metal electrodes subjected to electric fields ranging from 0.5 to 2.5 MV/cm for pulse durations of 3 to 10 ns. We used two high-voltage pulsers for these tests; a 500- to 700-kV, 72-Ω pulser that generated a 3-ns gaussian pulse; and a 2-MV, 60-Ω pulsér that generated a 10-ns flat-top pulse with a 1-ns risetime. The high voltage levels allowed emission studies using electrode spacings of several millimeters to several centimeters. Our studies emphasized bare and anodized aluminum surface shaving surface finishes that ranged from rolled stock to machined finishes of 2 to 400 μin. roughness. We also investigated polished stainless steel and brass. Emphasis was on first-shot performance with subsequent pulses applied to check for possible conditioning. The background pressure was typically 5 x 10^{-5} Torr. Our studies showed that for 10-ns pulse lengths, anodized aluminum surfaces could hold off more than twice the electric field strength of bare aluminum surfaces without appreciable electron emission. Anodized surfaces performed well at 1.0 to 1.5 MV/cm, while bare surfaces emitted at 0.5 to 0.7 MV/cm. For the shorter, 3-ns pulse lengths, anodizing was less effective at improving suppression of electron emission, while surface finish became the important factor. Electrodes with surface finishes of 40-μin. or better roughness performed well at field strengths of up to 2.4 MV/cm. The behavior of velvet cloth as an emitter was also investigated using the 3-ns pulser. We found that velvet would emit within 3 ns at field strengths approaching 100 kV/cm. 9 refs., 9 figs.

18853 (UCRL—97573) Causes of damage in multilayer dielectric coatings exposed to high average power visible laser radiation. Aikens, D.M.; Taylor, J.R. (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 12p. (CONF-8710165—6). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005363/JAW.

From Boulder damage symposium; Boulder, CO, USA (26 Oct 1987).

Causes of damage in multilayer dielectric coatings exposed to high average power visible lasers have been examined. Damage has been seen to be related to coating defects, surface contamination, and coating absorption. Defects and contamination, particularly those larger than 4um, have been observed to significantly lower the damage threshold for high reflective coatings. Attempts have been made to visually evaluate defects and surface contamination prior to damage in order to find correlation with the damage threshold. The methods used to evaluate coating defects and conduct high average power damage testing as well as test results are presented. This work demonstrates the value of controlling sources of defects in manufacture and contamination for use in high average power visible laser systems. 7 refs., 7 figs., 4 tabs.

18854 (AD-A—186004/8/XAB) Development of a low-noise 10 K J-T (Joule-Thomson) refrigeration system. Technical report (Final). Little, W.A. (MMR Technologies, Inc., Mountain View, CA (USA)). 15 Jun 1987. 6p. NTIS, PC A02/MF A01.

This report summarizes work done on the development of a low-noise Joule-Thomson, microminiature refrigeration system designed for 10 K operation. Topics discussed include: calculation of phase diagram of mixtures of certain hydrocarbon gases with nitrogen using the Benedict-Webb-Rubin equation of state; the setup of a magnetron-enhanced sputtering system to allow sputtering a layer of adhesive on the glass substrates with a much-better-defined thickness than can be laid down using the older screen printing method; redesign of H_3 refrigerator test stage, redesign of mixed-gas heat exchanger, refrigerator fabrication, and gas cleaner.

18855 (CEA-CONF—9122) Decay of the Zero Voltage State of a Josephson Junction Shunted by an Adjustable Impedance. Turlot, E.; Linkwitz, S.; Martinis, J.M.; Esteve, E.; Urbina, C.; Devoret, M.H.; Grabert, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique). Aug 1987. 3p. (CONF-870873—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751081/JAW.

From 18. conference on low temperature physics; Kyoto, Japan (20 Aug 1987).

The decay of the zero voltage state of a Josephson junction shunted by an adjustable transmission line has been calculated. The junction obeys a generalized RSJ model with a time delayed damping term. In the low damping region of energy diffusion limited decay, the decay rate depends on the delay time in an oscillatory manner. In contrast, in the moderate-to-high damping region, the decay rate depends monotonically on the delay time. We propose an experimental set-up in which the delay time can be varied in situ by changing the length of the transmission line leaving all the other junction parameters unchanged. The experiment should provide a test of the theoretical predictions of the influence of damping on the pre-exponential factor of the rate.

18856 (IFVE-OEA—86-184) Study on the dynamics of executive electromechanism with thyristor commutator for cryogenic systems. Popov, V.V.; Sokolov, B.V.; Ustinov, E.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703209/JAW.

The paper presents the study results of the executive electromechanism dynamics parameters for cryogenic-helium systems, circuitry, and constructive decisions for pulsed servoamplifiers. Recommendations on using contactless commutators to control asynchronous electric motors of cryogenic-system fittings and electrophysical units are given. 7 references, 7 figures.

18857 (IFVE-OUNK—86-226) Calorimetric technique for measuring liquid helium flow rate. Ageev, A.I.; Bozhko, Yu.G.; Zhirnov, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701308/JAW.

A calorimetric method for measuring liquid helium flow rate is treated. The system is implied for measuring single-phase helium ranging from 3 to 50 g/s. The main measuring error is 6%. The flowmeters design, measuring apparatus and software are described. The influence of the measured parameters errors on the accuracy of helium flow rate measuring has been analyzed. 10 refs.; 2 figs.; 2 tabs.

18858 (PB—88-119581/XAB) Bulletin of the Electrotechnical Laboratory, Vol. 49, No. 1, 1985. (Electrotechnical Lab., Sakura, Ibaraki (Japan)). 1985. 82p. NTIS, PC E05/MF A01.

Text in Japanese with English abstracts; and three articles in English. See also PB—85-108306.

Contents include: microwave-imaging systems; addition and multiplication using product of sum Josephson logic; length discrimination in hypercomplex type cells of cat striate cortex; cross sections of $^{12}c(n,\alpha)^{9}Be$ and $^{12}c(n,n'3\alpha)$ reactions at neutron energies from 10.2 to 11.0 MeV (in english); the specific volume of a field-reversed configuration and its application to stability analysis (in english); restoration of images with missing high frequency components by minimizing the l1 norm of the solution vector (in english); some technical points in conversion from VTAM-f to VTAM-G.

18859 **(PB—88-131859/XAB) Development of partially-stabilized pulsed superconducting magnets.** Tateishi, H.; Onishi, T.; Komuro, K.; Koyama, K. (Electrotechnical Lab., Sakura, Ibaraki (Japan)). 1987. 11p. NTIS, PC E07.

Text in Japanese; Included in Bulletin of the Electrotechnical Laboratory, Vol. 51, No. 2-3, 10-20(1987).

Two types of pulsed superconducting cables and four pulsed superconducting magnets were developed in order to investigate basic problems in constructing ohmic heating coils of a tokamak-type fusion reactor. The authors found that a compacted cable is superior in mechanical rigidity and a braided cable is superior in cooling capacity as a conductor of pulsed magnet. Stored energy and a maximum field of a magnets are 78kJ and 6T, 68kJ and 4T, 375kJ and 6T, and 363kJ and 3T, respectively. Some of these magnets quenched in pulsive operations due to excessive ac losses or macroscopic wire motions. Therefore, main conditions for operating pulsed magnets without quenching are (1) to make ac losses low enough to be cooled with liquid helium existing near at the conductor surface by reducing filament diameter to the order of 10 micrometers and using CuNi as matrix effectively, and (2) to prevent macroscopic wire motions by partial solderfilling of a cable or winding a magnet with strong tension.

18860 **(PB—88-131867/XAB) Development of MJ-class pulsed superconducting magnets stabilized by high-purity aluminum.** Tateishi, H.; Komuro, K.; Nomura, H.; Onishi, T . (Electrotechnical Lab., Sakura, Ibaraki (Japan)). 1987. 14p. NTIS, PC E07.

Text in Japanese; Included in Bulletin of the Electrotechnical Laboratory, Vol. 51, No. 2-3, 21-34(1987).

Two pulsed superconducting magnets were developed to establish the design base for an ohmic heating coil of a tokamak-type fusion reactor. Their stored energy and a maximum field are 4 MJ/6.4T and 3 MJ/6.6T, respectively. A three-stage twisted cable was designed for the conductor of the magnets. High-purity aluminum was adopted to achieve an operation at high current density and cryostability at the same time. A CuNi-clad composite was also adopted to reduce ac losses. As the authors attached importance to the prevention of wire motion, they compressed the magnets by a pressure equivalent to the maximum electromagnetic force and stiffened the windings before energization.

18861 **(PB—88-131875/XAB) Stability design of a high-current-density superconducting magnet using 3 kA-Class Nb_3Sn superconductors.** Umeda, M.; Watanabe, M.; Kimura, Y. (Electrotechnical Lab., Sakura, Ibaraki (Japan)). 1987. 7p. NTIS, PC E07.

Text in Japanese; Included in Bulletin of the Electrotechnical Laboratory, Vol. 51, No. 2-3, 114-120(1987).

The thermal stability of a superconducting magnet having a clear bore of 40 cm and a stored energy of approximately MJ was investigated. The unit pancake of the magnet was cowound with a stainless steel tape and a conductor to give good rigidity to the magnet avoiding the conductor motions. The thermal stability of the magnet was increased by this winding method. Minimum propagation energy at the design point (10T, 2kA) was calculated to be 28.3mJ. The value corresponds to 1% of mechanical elastic energy which the conductor has at the design point. The magnet designed and constructed on the basis of this thermal stability criterion was successfully tested without quenching. The average current density of the magnet was 74A/mm squared at 10T.

18862 **(PB—88-131883/XAB) Development of aluminum-stabilized 10-kA-Class cryostable Nb_3Sn superconductors.** Umeda, M.; Watanabe, M.; Kimura, Y. (Electrotechnical Lab., Sakura, Ibaraki (Japan)). 1987. 8p. NTIS, PC E07.

Text in Japanese; Included in Bulletin of the Electrotechnical Laboratory, Vol. 51, No. 2-3, 138-145(1987).

The authors have developed 10-kA class aluminum-stabilized, cryostable superconductors composed of Nb_3Sn strand wires, pure aluminum stabilizer, and hard copper. The conductor of this class corresponded to a conductor for a unit coil of 10-MWh class toroidal SMES. One double-pancake coil was wound with this conductor and could produce 10.1 T in a backing field of 8 T at a current of 10 kA. The results obtained satisfied the estimation based on the coil specifications.

18863 **(PB—88-131891/XAB) Conceptual design on 40-TJ-Class toroidal superconducting energy-storage plant.** Umeda, M. (Electrotechnical Lab., Sakura, Ibaraki (Japan)). 1987. 17p. NTIS, PC E07.

Text in Japanese; Included in Bulletin of the Electrotechnical Laboratory, Vol. 51, No. 2-3, 153-169(1987).

Superconducting magnet energy storage using a toroidal magnet (T-SMES) has a higher energy density and less magnetic leakage than that using a solenoidal magnet. For commercializing the T-SMES in the future, the cost-down of the reinforce materials, superconductors, and stabilizing materials will be required. The lines of research and development for these materials were investigated. The results showed that the cost of the reinforce materials withstanding a stress of 800 MPa at the design point was required to be less than $350/ton and the current density of superconductors should be more than 80 A/(mm squared) at 10 T.

18864 **(PB—88-855507/XAB) Thin superconducting films: sputtering, characterizations, and applications. January 1975-December 1987 (citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for January 1975-December 1987.** (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 141p. NTIS PC N01/MF N01.

This bibliography contains citations concerning the theories, production, characterizations, and applications of thin superconducting films. Sputtering techniques for fabricating thin superconducting films from transition metals, rare earth compounds, aluminum group metals, and germanium group metals are discussed. Their electrical, magnetic, and thermal properties are also examined. Topics include critical characteristics, transition temperatures, superconductive tunnelling and junctions, electrical impedances and energy gaps, persistent currents, and size effects. Thin superconducting film applications include optical detection, optical switching, Josephson junctions, microwave devices, and surface acoustic devices. (Contains 302 citations fully indexed and including a title list.)

18865 **A suspension system for superconducting super collider magnets.** Nicol, T.H.; Niemann, R.C.; Gonczy, J.D. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL 60510). pp 533-538 of Proceedings of the eleventh international cryogenic engineering conference. Klipping, G.; Klipping, I. Stoneham, MA; Butterworth Publishers (1986). (CONF-860437—).

From 11. international cryogenic engineering conference; Berlin, F.R. Germany (22 Apr 1986).

The design of a suspension system for the Superconducting Super Collider (SSC) presents many interesting problems to the cryostat designer. The suspension system must be strong enough to maintain the position of the cold mass during shipping, installation, and potential seismic conditions, it must be structurally stable over the anticipated 20 year life of the machine, and it must meet these constraints within the confines of a very strict allowable heat load. This paper describes various design alternatives considered for the SSC suspension and details the design and analysis of the reentrant post type supports chosen for the project. The results of structural, creep, and thermal tests on prototype assemblies are compared with predicted results.

18866 **(LA—11143-T) An evaluation of four quantitative laboratory fume hood performance test methods.** Woodrow, L.M. (Los Alamos National Lab., NM (USA)). Nov 1987. Contract W-7405-ENG-36. 216p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88005014/JAW.

Four quantitative laboratory fume hood performance test methods were evaluated, including: EPA uranine dye; ASHRAE Freon; EPA SF_6; and modified EPA SF_6. Each of these methods were evaluated, based on: variability and reproducibility; practical applications for field use; and the amount of leakage detected at the hood face. Testing was done on a hood in both the bypass and auxiliary-air supplied modes, and at five average face velocities - 60, 80, 100, 125, and 150 fpm. The ASHRAE Freon method was most sensitive for the bypass hood. Statistical analysis of the variability and reproducibility of the methods showed the repeat calibrations of the ITI Leakmeter to be the only factor which was significantly different. Each of the methods had problems which limited their field applicability. The results indicated that leakage from the hood face did not change significantly with the range of face velocities tested for either the bypass or auxiliary hood. 47 refs., 16 figs., 6 tabs.

18867 (SAND—87-2780C) Intelligent control of robot manipulators in hazardous environments. Harrigan, R.W. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 5p. (CONF-880236—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003305/JAW.

From COMPCON spring '88; San Francisco, CA, USA (29 Feb 1988).

The characteristics of hazardous environments and the impact these have on robot manipulator system control are reviewed. In particular, computer based reasoning must be integrated into the control of robot manipulators to allow successful application to such environments. Computing architectures and the concomitant software structures necessary to support both the high level reasoning and low level servo control requirements are discussed in the context of prototype robot systems. 7 refs., 2 figs.

18868 Experimental criticality data comparing organic with water moderation. Bierman, S.R.; Smolen, G.R.; Matsumoto, T. (Pacific Northwest Lab., Richland, WA). *Transactions of the American Nuclear Society;* **54**: 195-196(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

A joint US-Japan Criticality Data Development Program was established in 1983 under a Memorandum of Agreement (MOA) between the US Dept. of Energy (USDOE) and the Power Reactor and Nuclear Fuel Development Corp. of Japan (PNC). As part of this joint data development program, a criticality experimental program to provide a technological data base on nonreactor systems of plutonium-uranium mixtures was started in the USDOE Critical Mass Lab. at Hanford, Washington. The results of a series of experiments in this program, designed to provide data for comparing organic with aqueous moderated plutonium-uranium systems, are presented in this paper.

18869 Dynamic subcriticality measurements using the ^{252}Cf-source-driven neutron noise method. Mihalczo, J.T.; Blakeman, E.D.; Ragan, G.E.; Johnson, E.B.; Seino, H. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **54**: 207-208(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

This paper describes dynamic measurements of the subcritical neutron multiplication factor using the ^{252}Cf-source-driven neutron noise analysis method for a tank containing uranyl nitrate solution. These experiments are part of a program of collaboration between the US Dept. of Energy and the Power Reactor and Nuclear Fuel Development Corporation of Japan to study criticality safety related to the development of fast breeder technology.

18870 ^{252}Cf-source-drive neutron noise measurements for three interacting tanks of uranyl nitrate solution. Mihalczo, J.T.; Blakeman, E.D.; Ragan, G.E. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **54**: 208-209(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

The subcritical neutron multiplication factor has been measured by the californium-source-driven neutron noise analysis method for configurations of three interacting solution bottles. These experiments are the first application of this method of measuring subcriticality for an interacting system of three solution tanks and further assess the capability of this method for interacting arrays.

18871 (SAND—87-2882C) Development of circumferential impact limiters for a defense high level waste shipping cask. Zimmer, A.; Koploy, M.A.; Rickard, N.D.; Madsen, M.M.; Uncapher, W.L. (Sandia National Labs., Albuquerque, NM (USA); GA Technologies, Inc., San Diego, CA (USA)). 1988. Contract AC04-76DP00789. 8p. (CONF-880201—5). NTIS, PC A02. Order Number DE88005169/JAW.

From Waste management '88: symposium on radioactive waste management; Tucson, AZ, USA (26 Feb 1988).

Circumferential honeycomb impact limiters provide lightweight, low-volume impact protection for nuclear waste shipping casks with circular cross sections. GA Technologies has developed an empirical procedure for designing circumferential honeycomb impact limiters to limit the impact g-level to a predetermined level. Sandia National Laboratories has performed a series of tests demonstrating that the circumferential honeycomb impact limiters are effective and can be adequately designed using this empirical procedure. Circumferential honeycomb impact limiters are currently used on the Defense High Level Waste truck shipping cask and are planned for use on several new casks which are scheduled for development during the next few years. This paper describes the structural design of the circumferential honeycomb impact limiters, presents the empirical design procedure for predicting the impact g-level and required volume of honeycomb, and compares test results with predicted results. 1 ref. 1 fig.

18872 Effects of stratification on thermal energy storage in aquifers. Kannberg, L.D.; Vail, L.W. (Pacific Northwest Lab., Richland, WA). pp 1288-1292 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—). Contract AC06-76RL01830.

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879304.

A study was conducted to evaluate the impacts of aquifer stratification on the thermal energy recovery efficiency of aquifers being used as thermal energy storage reservoirs. A geohydrothermal model was applied parametrically for idealized aquifers having perfect hydraulic stratification (i.e., no fluid transfer between layers). The recovery efficiency is displayed as a function of Fourier number for idealized aquifers having alternating permeable and impermeable layers. Three ratios of impermeable to permeable layer thicknesses were evaluated. Results are presented for the first and fifth operating cycles. A clearly defined minimum recovery efficiency is observed as a function of Fourier number with the minimum occurring for Fourier numbers between 0.1 and 1. Significant improvement in energy recovery is eviedent between the first and fifth cycles. Simple methods of utilizing the results are presented. Stratification degrades the performance of the system. Stratification can be expected to be a significant factor for many aquifer thermal energy storage systems because aquifer layering will frequently have thicknesses for which stratification effects are most severe (between 0.3 and 5 m).

18873 (PNL-SA—15338) Rationale for the design of monitoring well screens and filter packs. Schalla, R.; Walters, W.H. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1988. Contract AC06-76RL01830. 24p. (CONF-880150—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005630/JAW.

From American Society for Testing Materials committee C-26 on nuclear fuel cycle; Albuquerque, NM, USA (26 Jan 1988).

Well screens and filter packs are used extensively in the water well industry. Water supply wells are designed with large diameters to accommodate high capacity pumps for municipal, industrial, and irrigation uses. Monitoring wells serve a different purpose, thus have some different design requirements. Monitoring wells are used to collect groundwater samples for chemical evalua-

tion and are typically smaller in diameter and have shorter screened intervals. Monitoring well design, particularly well screens and filter packs, must meet specific requirements. Unlike water wells, monitoring wells usually have an artificial filter pack and often a secondary filter between the formation and well screen. The designs of well screens and filter packs are more critical for monitoring wells than for water wells, because monitoring wells serve as sampling ports in an aquifer and must minimize disturbance of water chemistry and hydrology. Currently, screen and filter pack requirements for monitoring wells have been only partially addressed by the technical community. Specific technical requirements should include filter pack parameters (i.e., uniformity coefficient, effective size, kurtosis, skewness, roundness, sphericity, and mineralogy). The method of filter pack placement, which involves particle settling through borehole fluids, is also important, particularly in relation to the nature of the geologic materials, the slot type and size of the screen, and the water level in the well. 21 refs.

4203 Lasers

REFER ALSO TO CITATION(S) 18909, 18945, 19752, 19937, 20320, 20392, 20433, 20434

18874 **(AD-A—185866/1/XAB) R and D progress report and financial progress report for the period 28 March 1987 through 1 May 1987.** (Schafer (W.J.) Associates, Inc., Chelmsford, MA (USA)). 16 Jun 1987. 9p. (WJSA-KG—87-0641). NTIS, PC A02/MF A01.

During April, WJSA interacted with NRL on the previously developed approach for examining the effect of autozoom on DF Pulsed Chemical Laser (PCL) performance as it applied towards investigating the Boeing RPDF configuration, including the illumination profile that Boeing measured in RPDF. The key questions addressed were: to what extent is autozoom a problem in a 40 cm initiation height device; would the F_2 profile Boeing selected serve to achieve the goal of a uniform $D_2 + F_2$ burn throughout the cavity; are there other performance-robbing processes associated with nonuniform initiation. To answer those questions, an approach was developed to model the three-dimensional illumination intensity distribution within the gain medium, first without, and then with fluorine present; both in an untailored uniform 16% concentration, and in a tailored profile with a 16% average fluorine concentration.

18875 **(AD-A—185884/4/XAB) Space-based blue-green laser. Technical report (Final), 9 June 1980-6 August 1981.** Hsia, J.C.; McGeoch, M.W.; Klimek, D.E.; Moran, J.; Pike, C.T. (Avco-Everett Research Lab., Everett, MA (USA)). Oct 1981. 251p. NTIS, PC A12/MF A01.

An experimental and theoretical program was completed that thoroughly characterizes the e-beam sustained-discharge HgBr laser. The preliminary design of a 100-Hz, 2-J HgBr laser was performed. From measurements of HgBr fluorescence efficiency as a function of E/N the primary laser excitation process has been identified as the collisional excitation of $HgBr_2$ by electrons. A self-consistent set of excitation cross sections is derived from the experiment. The formation efficiency of HgBr(B) in a discharge is 6%.

18876 **(AD-A—185885/1/XAB) Characterization of Er,Cr:YSGG. Final report, 1 July-31 December 1986.** Moulton, P.F. (Schwartz Electro-Optics, Inc., Concord, MA (USA)). 3 Jun 1987. 36p. NTIS, PC A03/MF A01.

A study of the spectroscopic and laser properties of the crystal erbium-and chromium-doped yttrium scandium gallium garnet (Er, Cr:YSGG) was carried out. The absorption spectra form 300-1700 nm and the emission spectra in the regions around 800, 1600, and 2800 nm were measured, along with the kinetics of emission and decay under pulsed excitation. Energy levels of the erbium ion were determined. Analysis of the data shows that energy transfers from excited chromium ions to erbium ions with near-100% efficiency. The 2800-nm-region laser performance of Er,Cr:YSGG, under flashlamp pumping conditions was observed and found to be superior in some aspects to other erbium-doped crystals.

18877 **(DOE/ER/13761—2) Doubly periodic output from a dye laser pumped by a free-running argon laser.** McMackin, I.A.; Radzewicz, C.; Raymer, M.G. (Rochester Univ., NY (USA). Inst. of Optics). 1987. Contract FG02-87ER13761. 4p. (CONF-870488—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005027/JAW.

From 15. international conference on quantum electronics; Baltimore, MD, USA (27 Apr 1987).

Experiments were performed with a single-line argon-ion laser pumping a three-mirror, folded cavity dye laser containing a single-plate birefringent tuner. This resulted in multimode dye laser operation with a center frequency of 585 nm and a line width less than 1 A. The dye laser field and the power spectra were modulated with a period of n δ, where δ is the dye laser mode spacing. As predicted the strength of the modulation is larger for the n = 7 case. (WRF)

18878 **(DOE/ER/45056—6) UV-induced color centers and gain measurements in Ce^{3+}:$YLiF_4$.** Lim, Ki-Soo; Hamilton, D.S. (Connecticut Univ., Storrs (USA)). Jan 1988. Contract FG02-84ER45056. 102p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005402/JAW.

The origin of the laser performance limitation characteristis of Ce^{3+}:YLF have been identified and studied. To understand how stable and transient absorption centers are produced, several experiments were done including temperature dependence of transient decay times, spectral characteristics, growth kinetics, thermal or optical bleaching of these centers, and pump energy dependence. It is shown that the production of these centers results from a resonant two-photon absorption process or excited-state absorption which ionizes trivalent cerium ions. Once in the conduction band, the electrons from the cerium ions can be trapped temporarily at other trivalent cerium sites or permanently pre-existing fluoride vacancies, resulting in transient or stable color centers respectively. In order to clarify the effects of these color centers on the laser gain, single pass gain measurements were done as a function of laser pump repetition rates for several different temperatures. The possibility to improve the Ce^{3+}:YLF laser with thermal and optical bleaching of these absorption centers is discussed. The energy levels and structure of Ce^{3+}:YLF is discussed with the absorption and fluorescence spectra, and the possibility of the thermal lensing effect is discussed. Experimental techniques used to characterize the process responsible for the transient absorption are presented. The stable absorption bands, which are observed along with the transient absorptions, are discussed, and their polarization dependence, growing, and bleaching are presented. The single pass gain measurements are presented to explain several lasing problems found in Ce^{3+}:YLF, and possible gain improvement is discussed. (LEW)

18879 **(DOE/ER/45056—7) Energy transfer and nonlinear optical properties at near ultraviolet wavelengths: Rare earth 4f → 5d transitions in crystals and glasses: Progress report for the period June 1, 1987 to May 31, 1988.** Hamilton, D.S. (Connecticut Univ., Storrs (USA)). Jan 1988. Contract FG02-84ER45056. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005403/JAW.

The project has considered several aspects of the optical properties of lanthanide (rare-earth) doped crystals and glasses at near ultraviolet wavelengths. Measurements of the optical gain and loss at 325 nm in Ce^{3+}:$LiYF_4$ are presented. In addition to creating a cerium ion population inversion, the ultraviolet pumping forms transient and stable color centers via the excited cerium states. Crystals of Cr^{3+}:GSGG show several sharp absorption lines in the 310 nm to 340 nm region which we have identified as transitions of the Gd^{3+} ion. Excitation spectra taken by monitoring the Cr^{3+} luminescence shows that a $Gd^{3+} \rightarrow Cr^{3+}$ energy transfer process is active in this material. Measurements of the time dependance of the Cr^{3+} fluorescence following pulsed laser excitation of the Gd^{3+} ions indicates the characteristic time over which this energy transfer occurs. The 5d → 4f transitions of cerium doped crystals are generally thought to have unity quantum efficiency of luminescence at room temperature. Measurements of the fluorescence lifetimes of the 5d → 4f fluorescence transitions in Ce^{3+}:CaF_2, Ce^{3+}:$LiYF_4$, Ce^{3+}:YAG, Ce^{3+}:fluoroberyllate glass, and Ce^{3+}:ZBLA glass at 300 K and 77K are presented. Progress in the construction of a high temperature oven with full optical access is also discussed. Cerium

doped solids have the potential for laser action on the 5d → 4f transitions. Such laser would be broadly tunable toward the near ultraviolet. Initial measurments of potential cerium doped glasses for such laser devices is dicussed. Progress has been made on the study of laser-induced grating formation in impurity doped solids. A multi-mode pulsed Nd:YAG laser has been used to write such transient gratings in Cr^{3+}:Al_2O_3. Extensive repair of the excimer laser to be used for grating formation in the near ultraviolet is also described.

18880 **(LA-UR—87-4245) Projected performance of rf-linac-driven free-electron lasers in the VUV and soft x-ray regions.** Newnam, B.E. (Los Alamos National Lab., NM (USA)). Dec 1987. Contract W-7405-ENG-36. 8p. (CONF-880318—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004294/JAW.

From Topical meeting on free-electron laser applications in the ultraviolet; Cloudcroft, NM, USA (2 Mar 1988).

A multidisciplinary team of Los Alamos scientists, supported by the US Department of Energy, has been developing the requisite technologies to extend free-electron laser (FEL) operation from infrared and visible wavelengths into the extreme-ultraviolet below 100 nm using rf-linear accelerator technology. The goal is to establish an XUV Free-Electron Laser User Facility, the next-generation light source that will make available to researchers optical power more than one-million times greater than provided by synchroton light sources. Based primarily on a series of FEL oscillators driven by a single, rf-linac, the Los Alamos facility is designed to generate broadly tunable, picosecond-pulse, coherent radiation spanning the soft x-ray through the ultraviolet to the visible spectral ranges from 1 nm to 400 nm. The FEL facility design is discussed and performance predicted. 3 figs., 5 tabs.

18881 **(LA-UR—88-269) Calculation of harmonic radiation and nuclear coupling arising from atoms in strong laser fields.** Rinker, G.A.; Solem, J.C.; Biedenharn, L.C. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 9p. (CONF-880110—17). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005397/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

A numerical, time-dependent quantum mechanical model is used to describe the interaction of an isolated ion with an intense applied laser field, including both electron and nuclear degrees of freedom. Calculated results are presented. We find that the model ion radiates in low odd harmonics of the laser frequency, in qualitative agreement with experimental observations. In addition, it radiates strongly in the x-ray region, at frequencies comparable with the electron Rydberg frequency. Such radiation should be possible to observe in future experiments. If it exists, it could provide a basis for a reasonably coherent x-ray source. We find that the probability of induced nuclear excitation is small for higher electric multipoles, although observable probabilities are obtained under appropriate circumstances for L = 1. 2 refs., 12 figs.

18882 **Short wavelength coherent radiation: generation and applications; Proceedings of the Topical Meeting, Monterey, CA, Mar. 24-26, 1986.** Attwood, D.T.; Bokor, J. New York, NY; American Institute of Physics (1986). 459p. (CONF-860316—).

From Topical meeting on short wave length coherent radiation; Monterey, CA, USA (24 Mar 1986).

Papers are presented on XUV free electron laser oscillators, transition radiation as a coherent soft X-ray source, soft X-ray interferometry and holography, X-ray Fourier optics, optical gain at 185 nm in a laser-ablated inner-shell photoionization-pumped indium plasma, and recent progress in soft X-ray laser development at Princeton. Attention is also given to multiquantum processes at high field strengths, X-ray Bragg optics, a gain experiment in a neon-like copper plasma, the VUV photolysis of acetylene in the 110-135 nm region, soft X-ray emissions from various targets irradiated by long wavelength lasers, the generation of tunable intense coherent radiation around 126 nm with an argon excimer laser, aand lifetime measurements of perturbed triplet states of the CO molecule.

18883 **Instability modelling of gas lasers.** Casperson, L.W. (Dept. of Electrical Engineering, Portland State Univ., P.O. Box 751, Portland, OR 97207). pp 10-14 of Optical chaos. Chrostowski, J.; Abraham, N.B. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860620—).

From Society of Photo-Optical Instrumentation Engineers international symposium: topics in optical and optoelectronic applied sciences and engineering; Quebec City, Canada (2 Jun 1986).

Instabilities in various classes of lasers are now well recognized phenomena, and in recent years these phenomena have become increasingly well understood. For most purposes gas lasers have been found to be the easiest systems to study, and many of the instability effects found in gas lasers have been at least qualitatively modelled. In our meeting presentation we review some of the basic concepts of laser instability modelling with emphasis on results pertaining to gas lasers. The more qualitative aspects of the presentation are briefly summarized in these notes.

18884 **Multimode instabilities in cw dye lasers.** Stroud, C.R. Jr.; Koch, K.; Chakmakjian, S.; Hillman, L.W. (The Institute of Optics, Univ. of Rochester, Rochester, NY 14627). pp 47-50 of Optical chaos. Chrostowski, J.; Abraham, N.B. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860620—).

From Society of Photo-Optical Instrumentation Engineers international symposium: topics in optical and optoelectronic applied sciences and engineering; Quebec City, Canada (2 Jun 1986).

New experimental results are presented which show the behavior of homogeneously broadened ring dye laser both below and above the threshold for the onset of the two-frequency instability. It is shown that the spectrum of the output of the laser is extremely sensitive to the detuning of the initial lasing frequency from the center of the gain curve. Spectral splittings as large as 340 A are reported. The close connection between this instability and the production of femtosecond mode-locked laser pulses is discussed.

18885 **Spontaneous oscillations in a single mode CO/sub 2/ laser in a Fabry-Perot cavity.** Lippi, G.L.; Abraham, N.B.; Puccioni, G.P.; Tredicce, J.R.; Narducci, L.M.; Arecchi, F.T. (Dept. of Physics, Bryn Mawr College, Bryn Mawr, PA 19010). pp 41-46 of Optical chaos. Chrostowski, J.; Abraham, N.B. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860620—).

From Society of Photo-Optical Instrumentation Engineers international symposium: topics in optical and optoelectronic applied sciences and engineering; Quebec City, Canada (2 Jun 1986).

The authors show the existence of self-pulsing at two characteristic frequencies in a single mode CO/sub 2/ laser for low pump rates. The dynamical behavior of the system as a function of the pump rate, cavity losses and detuning between atomic and cavity frequencies has been investigated. These results can be explained by a recently developed theoretical model which incorporates intensity dependent parameters.

18886 **Intrinsic optical bistability in systems of spacially distributed two-level atoms: Conditions of stability and instability.** Ben-Aryeh, Y.; Bowden, C.M.; Englund, J.C. (Research Directorate, AMSMI-RD-RE-QP, Research, Development, and Engineering Center, U.S. Army Missile Command, Redstone Arsenal, AL 35898-5248). pp 228-232 of Optical chaos. Chrostowski, J.; Abraham, N.B. Bellingham, WA; SPIE Society of Photo-Optical Instrumentation Engineers (1986). (CONF-860620—).

From Society of Photo-Optical Instrumentation Engineers international symposium: topics in optical and optoelectronic applied sciences and engineering; Quebec City, Canada (2 Jun 1986).

The authors use a fully quantum, many-body treatment to show mirrorless optical bistability in terms of the spacial properties of interacting two-level systems. The bistability effects are related to the coherent dipole-dipole interactions which introduce an inversion-dependent renormalization of the frequency (or relaxation). Conditions of stability and instability are discussed for a thin sample of two-level atoms with a width smaller than a wavelength. For a

long sample of two-level atoms, they find that the two phases of high transmissivity may coexist spacially in the material.

4204 Heat Transfer And Fluid Flow

REFER ALSO TO CITATION(S) 17573, 17765, 18219, 18405, 18501, 19990, 20638

18887 (AGARD-R—755) Special course on modern theoretical and experimental approaches to turbulent flow structure and its modelling. (Advisory Group for Aerospace Research and Development, 92 - Neuilly-sur-Seine (France)). Aug 1987. 263p. (CONF-8703237—). NTIS, PC A12/MF A01.

From Special course on modern theoretical and experimental approaches to turbulent flow structure and its modelling; Rhode-St.-Genese, Belgium (16 Mar 1987).

The large eddy concept in turbulent modeling and techniques for direct simulation are discussed. A review of turbulence modeling is presented along with physical and numerical aspects and applications. A closure model for turbulent flows is presented and routes to chaos by quasi-periodicity are discussed. Theoretical aspects of transition to turbulence by space/time intermittency are covered. The application to interpretation of experimental results of fractal dimensions and connection of spatial temporal chaos are reviewed. Simulation of hydrodynamic flow by using cellular automata is discussed.

18888 (AGARD-R—755, pp vp) **Lattice gas hydrodynamics.** Boon, J.PI.; Noullez, A. Aug 1987. NTIS, PC A12/MF A01. (CONF-8703237—).

From Special course on modern theoretical and experimental approaches to turbulent flow structure and its modelling; Rhode-St.-Genese, Belgium (16 Mar 1987).

The motivation for using a lattice gas to simulate hydrodynamics stems from the idea that the details of the microscopic properties should be unimportant to the macroscopic behavior of the fluid. So, whether the fictitious microworld one uses is a caricature of a real fluid does not matter as long as it produces correct hydrodynamics. In order to answer the question of whether the lattice gas hydrodynamics meets the goal of producing correct hydrodynamics, the constitutive elements are built up to construct a lattice gas and a model system is put to work. Computational aspects of hydrodynamic simulations are reviewed.

18889 (DOE/PC/80511—T10) Hydrodynamics, mixing, and segregation in gas fluidized beds: Technical progress report, 22 July 1987 to 21 October 1987. Chen, M.M.; Chao, B.T. (Illinois Univ., Urbana (USA). Dept. of Mechanical and Industrial Engineering). 1987. Contract FG22-85PC80511. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004674/JAW.

Efforts during this period have been focussed on the continuing study of the nature of the fluctuating motion of solids in fluidized beds and on a theoretical analysis of convective heat transfer to immersed surfaces. 19 refs., 3 figs., 3 tabs.

18890 (DOE/PC/90008—T2) Heat transfer investigations in a slurry bubble column: Quarterly report for the period October-December 1987. Saxena, S.C.; Vadivel, R.; Verma, A.K. (Illinois Univ., Chicago (USA). Dept. of Chemical Engineering). 1987. Contract AC22-86PC90008. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004348/JAW.

The small 10.8 cm diameter Plexiglas slurry bubble column has been operated in various modes and in different environments. With minor refinements in instrumentation, it has been used to measure heat transfer coefficients between a heat transfer probe bundle containing five 19 mm outer diameter and 188 cm long Plexiglas tubes and the air-water system. The heat transfer coefficients are reported for the central tube of the bundle which contains a 34 cm long heated brass section as a function of air velocity (0.04 to 0.42 m/s) and for different heat flux values. Data are also obtained as a function of time during which the system tends to move to acquire the steady state. Hydrodynamic condition of the column is also established by taking the gas holdup data, both average and local along the column, as a function of air velocity, water column height, and with and without the probe bundle in the column. Based on this experience an improved design for the single probe has been developed both for its fabrication as well as for its mounting in the column. The construction and installation of the probe is completed and a bulk of the elaborate heat transfer and hydrodynamic measurements are also completed as a function of operating and system parameters. 12 figs., 4 tabs.

18891 (FEI—1733) Technique for calculation of a three-dimensional coolant flow in rod boundles. Kumaev, V.Ya.; Leonchuk, M.P.; Dvortsova, L.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 31p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703159/JAW.

Application of methods for plotting Navier-Stokes equation finite-difference approximations in rate/pressure variables in rectangular grids to motion equation approximation in trigonal grids inserted into trigonal fuel element cluster geometry allowed one to construct a family of conservative difference circuits to calculate three-dimensional flows both in fuel-element-cluster and in space without fuel elements. Equation-solution algorithm, called PORTER, is resistant under Kurant numbers exceeding one. Application of partial runs in the cluster axial direction makes it possible to considerably increase the limiting Kurant number under which resistance is retained. Algorithm approbation taking blockage flowing-around problem solution as an example has shown that the calculated picture of coolant flow in the trace qualitatively agrees with the actual picture. 12 references, 8 figures

18892 (FEI—1766) Temperature distribution in a turbulent water flow under supercritical pressures circular tubes. Kirillov, P.L.; Kolosov, A.A.; Petrova, Eh.I.; Smirnov, A.M.; Sudnitsyn, O.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701424/JAW.

The results of experimental investigations of the water temperature distribution in a tube under pre - (3; 9 MPa) and supercritical (25 MPa) pressures are given. The experiments are carried out at a special test bed. The experimental part is a tube of the 1m length, the 10.06+-0.02 mm inner diameter and the 1.98+-0.02 mm wall thickness made of the 12Kh18N10T stainless stee, which is heated by conducting alternating current. Measurements of the water temperature in the flow are carried out simultaneously with the investigations of tube wall heat transfer using a chromium-nickel thermocouple. On the basis of the analysis of the data obtained the conclusion is made that the temperature profile in a turbulent flow core under supercritical pressures and medium-mass temperatures close to pseudocritical ones obeys the logarithm low. 4 refs.; 4 figs.

18893 (FEI—1804) Study on the burnout with variations of flow twisting over tube length. Pomet'ko, R.S.; Gorban', L.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703170/JAW.

Results of experimental investigation into regularities of heat transfer intensification in tubes with transition from untwisting flows to twisting ones and vice versa are given. Experiments were conducted on flowing freon-12 in a tube 10 mm in dia with two zones of independent heating at 1.06 MPa pressure, 500-3000 kg/m²s flow rate, 80 mm screw twisting pitch. Characteristic specific features of interaction processes of flow core with the screw and untwisting band. Main trends of changing critical heat flux in tubes with varied, in length, flow twisting are qualitatively explained. 4 references, 6 figures.

18894 **(FEI—1842) To calculating geometric and hydraulic characteristics of non-standard channels.** Isakova, L.Ya. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701430/JAW.

Channels with complex geometry appear near the limiting surfaces in reactor cores, steam-generators or other constructions, where rods or tubes form a right lattice. The channels of irregular configuraton unlike the channels of periodic lattices, which are called standard, are considered as non-standard. The analytical representation of geometric characteristics of the cells being a part of the non-standard channels is obtained for such channels. The surfaces widely met in practice: cylindrical, multiangular and mixed (having direct sections and sections with a designed curvature radius) ones are considered. 2 refs.; 5 figs.

18895 (IA—1427, pp 6) **Internal temperature maxima in radiatively heated droplets.** Gorin, B.S.; Spjut, R.E.; Bar-Ziv, E. (Massachusetts Inst. of Tech., Cambridge, USA; Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18896 (IA—1427, pp 145-146) **Characterization of micromixing in gas flow by Rayleigh scattering.** Yossifon, S.; Bar-Ziv, E. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18897 (IA—1427, pp 224) **Temperature control of power dissipating devices by thermoelectric heat pump.** Sinvani, M.; Adler, E. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18898 (IA—1427, pp 226) **Optimization of a thermoelectric cascade cooler.** Szapiro, S.; Shilon, M. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18899 **(IEN-DITRA—02/87) Sodium confluent rates of flow values, on 0,5 mixer, of a sodium italian SS-050 circuit component.** Walsh, L.M. (Instituto de Engenharia Nuclear, Rio de Janeiro (Brazil)). 1987. 9p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701443/JAW.

Sodium lines on different temperatures, during an emergency drainage on 0,5 mixer was found. To future valuation by DIMEC of tensions that occurs on that component of SS-050, the confluent rates of flow values were calculated. (L.M.J.).

18900 **Transient forced convection heat transfer in He II.** Kashani, A.; Van Sciver, S.W. (Applied Superconductivity Center, Univ. of Wisconsin-Madison, Madison, WI 53705). pp 654-658 of Proceedings of the eleventh international cryogenic engineering conference. Klipping, G.; Klipping, I. Stoneham, MA; Butterworth Publishers (1986). (CONF-860437—).

From 11. international cryogenic engineering conference; Berlin, F.R. Germany (22 Apr 1986).

Transient heat transfer measurements done on a copper tube, 3 mm in diameter and 2 m long, containing forced convection He II are reported. The present study is an extension of previous work in which steady state heat transfer was studied. A step heat input is applied to the middle of the tube once He II flow is established. The temperature is monitored at eight locations along the tube. Experimental temperature profiles are then compared with a numerical solution to the He II energy equation. The pressure is monitored at each end of the tube and a friction factor for He II is estimated. In the experiment the He II flow velocity is varied up to 90 cm/s. The He II bath is maintained at saturated vapor pressure. Data are reported at three bath temperatures: 1.65 K, 1.8 K and 1.95 K.

4205 Materials Testing

REFER ALSO TO CITATION(S) 18581, 18638

18901 **(CONF-871124—23) The preparation of TEM [transmission electron microscope] specimens from hazardous or difficult materials.** Sklad, P.S. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004071/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

The first, and often the most critical, step in any electron microscopy investigation is the preparation of an electron transparent specimen which is representative of the bulk material and in which the features of interest can be clearly observed and interpreted. However, for many materials of technological importance, specimen preparation procedures are far from routine. The application of standard, established techniques may be limited by material inhomogeneities, by physical constraints such as size or geometry, or by material constraints such as toxicity, radioactivity, or reactivity. Examples illustrating techniques for overcoming some of these difficulties will be reviewed. 25 refs., 10 figs.

18902 **(DOE/SF/15933—T1) Vapor-mist for lightweight high voltage space insulation systems: Final report.** Harrold, R.T. (Westinghouse Research and Development Center, Pittsburgh, PA (USA)). Mar 1987. Contract AC03-85SF15933. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE87011704/JAW.

The purpose of this research was to assess whether the new and emerging technology of vapor-mist dielectrics would be applicable as a high voltage pulse insulation for space-borne weapons and radar. This is a very important area in which new and lightweight forms of high voltage insulation are critically needed. The research tasks addressed in this project are listed below: estimate the performance of vapor-mist under zero gravity conditions, develop rapid misting techniques, determine the electrical strength of vapor-mist at radar frequencies, examine the electrical strength of vapor-mist exposed to pulse voltages with nanosecond rise times, and examine the heat transfer and cooling properties of vapor-mist. In this report the experimental results, analyses and theoretical aspects associated with the above tasks are detailed. Also, included are some measurements of the ultraviolet absorbance properties of vapor-mist, and the results of a microscopic examination of the electrode surfaces after pulse voltage breakdown in vapor mist. 12 refs., 25 figs., 2 tabs.

18903 **(DOE/SF/15954—T2) Thermionic Technology Program: A, Insulator test and evaluation: Final report.** Dobson, J.C.; Witt, T. (Rasor Associates, Inc., Sunnyvale, CA (USA)). 30 Nov 1987. Contract AC03-86SF15954. 91p. (NSR—25-15). NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88004707/JAW.

The Thermionic Technology Program (TTP) consisted of two major efforts, evaluation of insulators and evaluation of thermionic converters. This report details the work performed on the insulator phase of the program. Efforts were made to better understand the mechanisms involved in the electrochemistry of insulators at elevated temperatures by modelling the ionic transport through the various layers of the insulator package. Although rigorous analytic solutions could not be obtained owing to a lack of detailed data, a simplified model indicated that alumina should not fail by depletion of aluminum for thousands of years, whereas calculations for yttria revealed a far more rapid depletion of oxygen and consequently earlier failure. Methods for microscopic and electrical testing of cylindrical insulator samples were developed, and an improved test oven design was initiated. Testing of alumina/niobium cermet samples revealed rapid failure contrary to the theoretical predictions for alumina. Large discrepancies in the initial conduction activation energy among the various samples suggested that

different mechanisms could have controlled the conduction and hence the failure in different samples, although all had undergone nominally identical processing. The short lifetimes reveal how rapidly ambient conditions in thermionic power conversion can degrade the performance of insulating oxides. It was concluded that minor dopants could have been responsible for the early breakdowns. Thus, high purity materials with precise quality control will be necessary for trilayer package development. 35 refs., 28 figs., 5 tabs.

18904 (EGG-M—06487) Determination of residual strain fields on rail wheels using moire interferometry. Epstein, J.S.; Deason, V.A.; Reuter, W.G. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 8p. (CONF-8708213—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005547/JAW.

From SPIE international conference on photomechanics; San Diego, CA, USA (21 Aug 1987).

Moire interferometry was used to determine the residual strain fields in a rail wheel. Hoop, radial, and shear displacement fields were determined in a whole field manner using a novel four-beam moire interferometer. Diffraction gratings of 150 lines/mm were employed on the specimen surface. A system of data interpolation utilizing a simple control sample scheme was developed for field environments where sample loading occurs away from the optical device. Agreement was found between the moire technique and physical measurements of wheel contraction during sectioning. Marginal agreement was found with strain gage measurements. 5 refs., 10 figs.

18905 (IA—1427, pp 220-222) Instrumented impact testing system. Rosenthal, Y.; Adam, G.; Mark-Markovitch, M. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

18906 (NIIAR—25(706)) Analysis of errors in measuring external diameter methods of their basing. Kanashov, B.A.; Aleshechkin, L.V. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1986. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701519/JAW.

Different methods of product basing when measuring their geometric dimensions are considered. Experimental data on the effect of different methods of long cylindrical product basing on outer diameter determination error are analysed. Necessity of using kinematic sheme providing measurement error constancy in any point of measured product is shown. Principles of a floating measuring system and maximum feed back between the basing device and measuring system is formulated. The Kinematic scheme realizing this principle permits to decrease the outer diameter determination error and to reduce requirements to the quality of facility fabrication. 12 refs.; 10 figs.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 18659, 18704, 19060, 19063, 20287, 20663

18907 (BDX—613-3793) Electrophoretically deposited styrene-acrylate coatings for suppression of internal electromagnetic pulse effects. McLean,, M.J.; Sharp, D.J.; Hartman, E.F. (Allied-Signal, Inc., Kansas City, MO (USA). Bendix Kansas City Div.; Sandia National Labs., Albuquerque, NM (USA)). Nov 1987. Contract AC04-76DP00613. 14p. (CONF-880312—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003820/JAW.

From 33. symposium and exhibit on materials and processes for all industries; Anaheim, CA, USA (7 Mar 1988).

High energy Compton photoelectrons are released from metal surfaces of enclosures following exposure to electromagnetic pulses or x-rays emitted from nuclear bursts. These high energy electrons are particularly troublesome when emitted from high Z materials such as gold, and can cause damage to sensitive electronic systems by electrically overstressing electronic devices. Low electron-emission coatings, preferably a dielectric, can greatly reduce the Internal Electromagnetic Pulse (IEMP) response. Allied-Signal Inc., Bendix Kansas City Division and Sandia National Laboratory, Albuquerque (SNLA) have developed a dielectric coating approach which permits deposition of thin, uniform, and adherent styrene-acrylate films (25 μm or more) on metal housings. It is also shown that such coatings, when selectively applied on aluminum structures, can be used to mask against electrodeposition of Zn, Sn, and Au thereby providing both an overall IEMP resistant coating and also facilitating selective plating for solder attachments. Coatings were deposited from an aqueous colloidal solution of a styrene-acrylate copolymer and provided hard, clear films having bond strengths in excess of 1.24×10^7 Pa (1800 lbs/in.^{2}). 8 refs., 8 figs.

18908 (CONF-8609302—) ESSCIRC [European solid-state circuits conference] '86: Proceedings. (Technische Hogeschool Delft (Netherlands). Afdeling Elektrotechniek; Convention of National Societies of Electrical Engineers of Western Europe; Institute of Electrical and Electronics Engineers, Inc. United Kingdom and Republic of Ireland Section; Koninklijk Inst. van Ingenieurs, The Hague (Netherlands)). 1986. 227p. NTIS (US Sales Only), PC A11. Order Number DE88900346/JAW.

From 12. European solid-state circuits conference (ESSCIRC '86); Delft, Netherlands (16 Sep 1986).

This paper contains papers from the conference of European Solid-State Circuits. The areas covered by these papers are: Special memory and logic circuits, module libraries and design systems, silicon compilation, memories and gate-arrays, multipliers and module synthesis, design methodology for large custom VLSI processors, signal and image processors, analog principles and applications, switched capacitor chips and CAD, trends in design for testability, convertors and transducers, testing and SEM, VLSI data-management, sensors and power control, and verification and simulation. (LSP)

18909 (PB—88-131818/XAB) Bulletin of the Electrotechnical Laboratory, Vol. 48, No. 11, 1984. (Reifer Consultants, Inc., Torrance, CA (USA)). 1984. 73p. NTIS, PC E04.

Text in Japanese with English abstracts. See also PB—88-131800.

This Special Issue contains: Development of a high-power glass laser system; Actively mode-locked and Q-switched glass oscillator; Single-pulse switchout with an optical shutter; Glass laser amplifier; Trial manufacture of inside ellipse mirror for laser amplifier; Optical isolation by Faraday rotator; Control of high-power laser beam by using spatial filter; High-efficiency fourth-harmonic generation of high-power Nd laser radiation; Characteristics of ETL glass-laser system.

18910 (PB—88-855770/XAB) Low pass filters: design and theory. January 1984-December 1987 (citations from the INSPEC: Information Services for the Physics and Engineering Communities data base). Report for January 1984-December 1987. (National Technical Information Service, Springfield, VA (USA)). Jan 1988. 159p. NTIS PC N01/MF N01.

Supersedes PB—86-852530.

This bibliography contains citations concerning the theory, design, and synthesis of low pass filters. Included are references to studies of optimization, accuracy, parasitics, and response. Some citations include applications to demonstrate design advantages. (This updated bibliography contains 322 citations, 129 of which are new entries to the previous edition.)

18911 (SAND—87-0311) Quartz oscillator analysis. Wessendorf, K.O. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 33p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005886/JAW.

This paper develops an analytical modeling technique for a Pierce oscillator employing a quartz resonator and a bipolar transistor. The model is useful in predicting frequency, minimum gain required, and steady state signal levels of oscillation. This model is used to predict the operation of an actual 16MHz oscillator circuit. The circuit was modified to simulate changes in the resonator's motional resistance, R/sub m/, and the bipolar's base to emitter resist-

ance, h/sub ie/. The model was used to show how well the oscillator's performance could be predicted. If the circuit is characterized well, the oscillator's frequency can be determined within 10 ppM and the oscillation amplitude can be calculated to within +- 20% of actual measured values. 2 refs., 15 figs., 2 tabs.

18912 **(SAND—87-2828C) Considerations in GaAs standard cell design.** Grohman, M.; Conoscenti, A. (Sandia National Labs., Albuquerque, NM (USA); GigaBit Logic, Newbury Park, CA (USA)). 1987. Contract AC04-76DP00789. 4p. (CONF-880340—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003310/JAW.

From Southcon conference; Orlando, FL, USA (10 Mar 1988).

A radar system being developed at Sandia National Laboratories is required to perform a phase comparison between a reference and received waveform. In order to increase the range accuracy, it is necessary for the phase difference to be measured at speeds approaching 1 nanosecond. This speed requires the use of GaAs technology. This paper briefly describes the design of a GaAs phase detector consisting of about 400 gates using standard cells. The integrated circuit was constructed and preliminary tests were made. (JDH)

18913 **(UCRL—21014) Crossbar Switch: Final report.** (Silicon Connections Corp. (USA)). 19 Dec 1987. Contract W-7405-ENG-48. 72p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005418/JAW.

This study includes the investigation of two distinct Crossbar Switch configurations, three arbitration schemes, three pipelining modes, and a minimum of 6 common control functions. Individual "data-book" level descriptions of the switches are prepared, including high-level logic diagrams, function of each pin or bus, and timing information for each pin and bus. Additionally, specific proposals are made for: (1) a practical means of performing 100% functional at-speed testing of the chips requiring probing only a fraction of the full complement of I/O terminals, and parametric testing of 100% of the 2 mil pitch I/O terminals at wafer level, as well as; (2) a practical means and process flow for water level burn-in, including retests, prior to multi-chip assembly utilizing LP based interconnect technology. 12 refs., 24 figs., 15 tabs.

18914 **(WJSA—88-R-B-003) Delivery and development of a surface discharge incoherent pump source: Final report, [June 1987 through December 1987].** Connolly, J.J.; Schaefer, R.B.; Poirier, M.S. (Schafer (W.J.) Associates, Inc., Chelmsford, MA (USA)). Jan 1988. Contract W-7405-ENG-36. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005310/JAW.

This is the final report on work carried out from June 1987 through December 1987 sponsored by Los Alamos National Laboratory under contract number 9-X3H-1686G, entitled "Delivery and Development of a Surface Discharge Incoherent Pump Source." This work ws to experimentally design, fabricate, and characterize a surface discharge incoherent pump source in an annular geometry. A surface discharge is a plasma discharge between two electrodes placed upon a dielectric surface. A conducting backplane is placed behind the dielectric substrate. During initiation of the discharge capacitive coupling through the dielectric (i.e., a "displacement current") causes the discharge to form along the surface. The geometry of the surface discharge plasma can be varied. Previous reports include linear, rectangular, cylindrical, and zig-zag geometries. To our knowledge, the annular geometry reported here is unique. The annular surface discharge design, described below in detail, contains an outer ring electrode discharging to or from a pin at the center of the ring. The technical work reported here is comprised of two tasks. Task one was to design a large area disc shaped surface discharge which could be used in the laboratory for repeatable pulsed experiments to simulate the pump source currently employed by Los Alamos National Laboratory. Task 2 was to fabricate the pump source, operate it as the load of a pulse forming network, and characterize its electrical and optical properties. 17 figs., 4 tabs.

18915 **Microwave performance monitor application at the Bonneville Power Administration.** Street, M.A.; Borys, S.F. (Bonneville Power Administration, Portland, OR). *IEEE Transactions on Power Delivery;* PWRD-2: No. 4, 992-998(Oct 1987).

This paper describes BPA experience with a BPA - developed automatic performance monitoring system which monitors pertinent operational parameters of seven major BPA microwave systems. The Micorwave Monitor (MWM) System provides Operations and Maintenance personnel with continuous measurement of each system's performance. The MWM detects gradual MW system degradation and impending failures before an outage occurs. This allows maintenance visits to be scheduled in advance. In addition, the MWM isolates problems to specific sections of each microwave system allowing rapid location and repair. The MWM also performs automatic diagnosis, and only requires remote terminals at the ends of each microwave system. Having gained operational experience over several years, BPA can use the MW Monitor to evaluate BPA maintenance approach and procedures.

18916 **Liquid metal thermal electric converter Sand86-2823A.** Lukens, L.L.; Andraka, C.E.; Moreno, J.B.; Abbin, J.P. (Sandia National Labs., Albuquerque, NM). pp 1416-1422 of Proceedings of the 22nd intersociety energy conversion engineering conference. New York, NY; American Institute Aeronaut and Astronaut (1987). (CONF-870804—).

From 22. intersociety energy conversion engineering conference; Philadelphia, PA, USA (10 Aug 1987).

Technical Paper 879382.

Sandia National Laboratories is actively engaged in the evaluation and development of heat engine technologies applicable to dish electric systems. Preliminary heat engine technology assessment identified the Liquid Metal Thermal Electric Converter (LMTEC) concept as having the potential to meet the DOE's Solar Thermal Technology Program long term cost and performance goals with further engineering development. LMTEC work at Sandia has concentrated on three major areas; the conceptual design of a 25 kWe unit for mounting at the focus of a parabolic dish type solar collector, analytical modeling of the LMTEC to better understand its limitations and advantages, and the design, construction, and test of a single cell bench test module to validate analytical models, evaluate design concepts, and gain experience with materials.

4209 Waste Processing Plants And Equipment

18917 **(NYSERDA—87-16-Vol.2) Results of the combustion and emissions research project at the Vicon Incinerator Facility in Pittsfield, Massachusetts: Final report, Volume 2 (Appendices A-G).** (Midwest Research Inst., Kansas City, MO (USA)). Jun 1987. 357p. NTIS, PC A16. Order Number DE88004341/JAW.

The New York State Energy Research Development Authority (Energy Authority) contracted with Midwest Research Institute (MRI) to conduct a series of tests at the Municipal Solid Waste incineration facility operated by VICON Recovery Associates in Pittsfield, Massachusetts. The project was conducted in two phases. This final report presents the results of Phase 2. Phase 2 was directed to the monitoring of combustion variables and to the sampling and analysis of polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans, polychlorinated biphenyls, chlorobenzenes, chlorophenols, and polynuclear aromatic hydrocarbons in the combustion gases. Tests were conducted under several different incinerator operating conditions, including with different waste feeds, to identify any relationships between those compounds and the combustion variables and operating conditions. Compilations of the analytical chemical analyzers for semivolatile chemical emissions are tabulated, and quality assurance results are given.

18918 **(NYSERDA—87-16-Vol.3) Results of the combustion and emissions research project at the Vicon Incinerator Facility in Pittsfield, Massachusetts: Final report, Volume 3 (Appendices H-K).** (Midwest Research Inst., Kansas City, MO (USA)). Jun 1987. 247p. NTIS, PC A11. Order Number DE88004340/JAW.

The New York State Energy Research Development Authority (Energy Authority) contracted with Midwest Research Institute (MRI) to conduct a series of tests at the Municipal Solid Waste incineration facility operated by VICON Recovery Associates in Pittsfield, Massachusetts. The project was conducted in two phases. This final report presents the results of Phase II. Phase II was directed to the monitoring of combustion variables and to the sampling and analysis of polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans, polychlorinated biphenyls, chlorobenzenes, chlorophenols, and polynuclear aromatic hydrocarbons in the combustion gases. Tests were conducted under several different incinerator operating conditions, including with different waste feeds, to identify any relationships between those compounds and the combustion variables and operating conditions. Dioxin/furan homolog distribution graphs and a summary of daily field testing logs are given, as well as MM5 calculations and analytical data and calculations for chlorine, moisture, and percent ash.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 17482, 17483, 17484, 17488, 19268

18919 (DOE/METC—86/6043, pp 154-160) **Rapid pyrolysis with steam stabilization.** Albal, R.S.; Litka, A.F. (Avco Research Lab., Everett, MA). Jun 1986. NTIS, PC A18/MF A01. Order Number DE86006617/JAW. (CONF-860649—). Contract AC21-85MC22058.

From 6. annual gasification contractors' meeting; Morgantown, WV, USA (24 Jun 1986).

The objective of this contract is to obtain systematic, definitive kinetic data on rapid coal pyrolysis with steam stabilization under well defined conditions applicable to advanced gasifier designs. A moderately large-scale facility approaching a prototype unit was used. It was designed to provide a unique tool for the exploration of realistic coupled effects among coal properties, residence time, mixing, fluid dynamics, combustion gas properties, and chemistry. Application of slagging wall technology was demonstrated to provide structural protection and reduce the heat loss. Instrumentation was upgraded and the reactor configuration improved throughout the project as needs were defined. Conditions were achieved in the pyrolyzer where the yield was not limited by gross, time-averaged mixing. The main purpose of this new project is to make two further improvements. First, carry out experiments under reduced heat loss conditions in a near-adiabatic reactor, and second, further improve the instrumentation (the ability to obtain fully mixed product samples), and then obtain definitive overall reaction and global kinetic data.

18920 (N—88-12552) **Composite mechanics for engine structures.** Chamis, C.C. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1987. 35p. (NASA-TM—100176; E—3750; NAS—1.15:100176; CONF-870505—). NTIS, PC A03/MF A01.

From 32. international gas turbine conference and exhibition; Anaheim, CA, USA (31 May 1987).

Recent research activities and accomplishments at Lewis Research Center on composite mechanics for engine structures are summarized. The activities focused mainly on developing procedures for the computational simulation of composite intrinsic and structural behavior. The computational simulation encompasses all aspects of composite mechanics, advanced three-dimensional finite-element methods, damage tolerance, composite structural and dynamic response, and structural tailoring and optimization.

4220 Underground Engineering

18921 (AD-A—186360/4/XAB) **Centrifugal and numerical modeling of buried structures. Volume 2. Dynamic soil-structure interaction. Final report.** Shin, C.J. (Colorado Univ., Boulder (USA). Dept. of Civil, Environmental, and Architectural Engineering). 14 Jul 1987. 268p. NTIS, PC A12/MF A01.

See also Volume 3, AD-A186 361.

Soil-structure interaction under blast loading was investigated both experimentally in a 10 g-ton centrifuge and analytically by finite-element simulation. In the centrifuge experiments, circular pipes made of micro-concrete were buried in a dry sand and tested in the centrifuge to simulate the effects of gravity-induced overburden stresses which played a major role in controlling the soil stiffness and, subsequently, the response of the pipe. The blast loading was simulated by a pressure pulse generated by rupturing a burst disc in an impact generator. Surface stress gages and contact stress gages both made of polyvinylidene fluoride were built and calibrated to measure air blast magnitudes and contact pressures. The centrifuge experiments provided insight into the dynamic response of buried pipes and a data base for the verification of numerical results. These results were obtained by linear and non-linear finite element analyses of the experiments duplicating the surface overpressure loading. The suitabllity of constitutive relations for both soil and micro-concrete were verified by comparing test results and analysis. The effects of soil arching around the buried pipe was also delineated from both experiment and analysis.

18922 (AD-A—186361/2/XAB) **Centrifugal and numerical modeling of buried structures. Volume 3. A centrifuge study of the behavior of buried conduits under airblast loads. Final report.** Whittaker, J.P. (Colorado Univ., Boulder (USA). Dept. of Civil, Environmental, and Architectural Engineering). 14 Jul 1987. 349p. NTIS, PC A15/MF A01.

See also Volume 1, AD-A185 590.

The principal object of the research was to provide a better understanding of the behavior of the soil-structure interaction phenomena associated with buried conduits subjected to airblast loads. A parametric study was performed to experimentally determine the effects of airblast loads on 4-in-diameter micro-concrete pipes, embedded horizontally in a dry sand. The parameters varied in the study included the gravity level, the applied airblast pressure level, the relative density of the dry sand, burial depth of the structure, and the relative stiffness between the structure and the soil. A geotechnical centrifuge was used to create the proper in-situ stress conditions in the sample during each test. Dynamic stress gages were utilized to measure the applied airblast on the sample surface, the normal stresses acting at the soil-pipe interface, and in the free-field conditions. Proximitors positioned inside of the structures were used to measure the resulting deflections. The results of the experimental study verified the importance of testing models at increased gravity levels, and determined the feasibility of the dynamic stress gages for measurement of contact and free-field stresses. Interesting trends in contact stresses around the circumference of the pipe; variations of 20% in relative density of the sand produced no significant changes in contact stress levels.

4230 Marine Engineering

REFER ALSO TO CITATION(S) 18305

4240 Pollution Control Equipment

18923 (PB—88-125893/XAB) **Case studies of hazardous-waste treatment to remove volatile organics. Volume 1.** Allen, C.; Branscome, M.; Northeim, C.; Leese, K.; Harkins, S. (Research Triangle Inst., Research Triangle Park, NC (USA)). Nov 1987. 117p. NTIS, PC A06/MF A01.

See also Volume 2, PB—88-125901.

Case studies are presented for treatment of refinery wastes in a pilot-scale thin-film evaporator, the removal of volatiles from industrial wastewater for two steam strippers, and the removal of semivolatiles from water by steam stripping followed by liquid-phase carbon adsorption. The report provides data on removal efficiency, air emissions, process residuals, treatment costs, and process limitations. Details on sampling and analytical procedures, quality assurance, and process data are contained in the Appendixes (Volume II).

18924 (PB—88-125901/XAB) **Case studies of hazardous-waste treatment to remove volatile organics. Volume 2.** Allen, C.; Branscome, M.; Northeim, C.; Leese, K.; Harkins, S. (Research Triangle Inst., Research Triangle Park, NC (USA)). Nov 1987. 117p. NTIS, PC A06/MF A01.

See also Volume 1, PB—88-125893.

Case studies are presented for treatment of refinery wastes in a pilot-scale thin-film evaporator, the removal of volatiles from industrial wastewater for two steam strippers, and the removal of semivolatiles from water by steam stripping followed by liquid-phase carbon adsorption. The report provides data on removal efficiency, air emissions, process residuals, treatment costs, and process limitations. Details on sampling and analytical procedures, quality assurance, and process data are contained in the Appendixes (Volume II).

18925 **New filter efficiency tests being developed for the DOE.** Scripsick, R.C. (Industrial Hygiene Group, Health, Safety and Environment Div. of Los Alamos National Lab., P.O. Box 1663, Mailstop K486, Los Alamos, NM 87545). pp 345-363 of Fluid filtration: Gas. Volume I. Raber, R.R. Philadelphia, PA; ASTM (1986). (CONF-861060—).

From Symposium on fluid filtration; Philadelphia, PA, USA (20 Oct 1986).

The United States Department of Energy (USDOE) is considering adoption of new test specifications and new test techniques for quality assurance testing of nuclear grade high efficiency particulate air (HEPA) filters. Proposed new filter test specifications require penetration measurements to be made at a particle diameter in the range form 0.1 μm to 0.2 μm rather than at a particle diameter of 0.3 μm which is currently required. The new specifications are aimed at making penetration measurements at or near the size of maximum penetration for the current generation of nuclear grade HEPA filters. The new test specifications provide a high estimate of filter penetration relative to the predicted penetration of field challenges in terms of aerosol size and aerosol density. This conservative estimate is required to assure that USDOE air cleaning systems adequately protect public and worker health and the environment in the event of unplanned release of hazardous materials. Operational evaluation of a high flow alternative filter test system (HFATS) developed of the USDOE by Los Alamos National Laboratory is currently being completed. Interim results of this evaluation and results of laboratory and full-scale evaluations demonstrate that the HFATS is capable of providing measurements of filter penetration at specific sizes over the diameter range from —0.1 μm to —0.4 μ within the operational requirements of the USDOE Filter Test Facilities.

4250 Power Cycles

REFER ALSO TO CITATION(S) 18066, 18492

18926 **(N—88-11747) SPRE 1 free-piston stirling engine testing at NASA Lewis Research Center.** Cairelli, J.E. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1977. 15p. (NASA-TM—100241; E—3865; NAS—1.15:100241; CONF-880457—). NTIS, PC A03/MF A01.

From American Society of Mechanical Engineers Solar Energy Division conference; Golden, CO, USA (10 Apr 1988).

As part of the NASA funded portion of the SP-100 Advanced Technology Program the Space Power Research Engine (SPRE 1) was designed and built to serve as a research tool for evaluation and development of advanced Stirling engine concepts. The SPRE 1 is designed to produce 12.5 kW electrical power when operated with helium at 15 MPa and with an absolute temperature ratio of two. The engine is now under test in a new test facility which was designed and built at NASA Lewis specifically to test the SPRE 1. The SPRE 1, the NASA test facility, the initial SPRE 1 test results, and future SPRE 1 test plans are described.

18927 (NP—8770044, pp 380-402) **Development of general purpose stirling engine. Development of 3 KW class stirling engine for air conditioning (Displacer type).** Nomaguchi, Yu. (Mitsubishi Electric Corpration, Tokyo, Japan). 21 Sep 1984. (In Japanese). NTIS (US Sales Only), PC A20. Order Number DE88770044/JAW.

In Proceedings of parallel sessions for the 4th NEDO general assembly.

This is a report for 1982-83 on a displacer type engine. Design of an engine with 32% heat efficiency was made possible on the basis of such elemental technology as annular type heat exchanger, dual crank type output extraction program, pressurized crank chamber, and a low pressure-loss burner. Contribution to the engine design was made by the studies on such items as selection of a sealing material and its performance, characteristics of a heat exchanger and the thermal stress, efficiency of a burner, mechanical loss in the output extraction mechanism, initial performance of an engine, etc.. The first trial of engine-making and its performance test by varying the conditions led to the investigation on the correlation among the data obtained and the calculated values. (24 figs, 2 tabs)

18928 (NP—8770046, pp 979-1009) **Development of general purpose stirling engine.** Aug 1986. (In Japanese). NTIS (US Sales Only), PC A99. Order Number DE88770046/JAW.

In FY 1985 NEDO Annual Report.

This is the 1985 annual report on the stirling engine development project. Studies were made about engine designs, elements, trial operation, application systems and diversity of applicable fuels for stirling engines of 3 KW class air-heating and cooling displacer type (NSO3M), 3 KW heating and cooling two piston type (NSO3T), 30 KW heating and cooling (NS30A), and 30 KW class small size power engine (NS30). As regards NSO3M, modification was made for the control of pressure in the cylinder to reduce NOx production, improve durability and minimize size and weight. As to NSO3T, measures were taken for the improvement of the air preheater, enhancement of durability and minimization of weight, and the efficiency in the vicinity of 1,500 rpm was improved to the similar level as that achieved last year, with the maximum output of 3.7 KW. For NS30A, provision of smaller combustion chamber and thinner operating parts for a horizontal lateral basic engine resulted in the net engine heat efficiency of 33.8%. With NS30S-2, maximum output power of 34 KW was achieved by improving the pressure imbalance of the cylinders. NS30S-3 was made on an trial basis, with the efficiency similar to that obtained for the engine made in the previous year. (53 figs, 3 tabs)

43 PARTICLE ACCELERATORS

18929 **(CERN—87-11-Vol.1) New developments in particle acceleration techniques, Volume 1: Proceedings.** Turner, S. (ed.). (European Organization for Nuclear Research, Geneva (Switzerland)). 12 Oct 1987. 348p. (ECFA—87/110-Vol.1; CONF-8706147—Vol.1). CERN, European Organization for Nuclear Research, CH-1211 Geneva, Switzerland. Order Number TI88900326/JAW.

From Workshop on new developments in particle acceleration techniques; Orsay, France (29 Jun 1987).

A Workshop organized jointly by the European Committee for Future Accelerators (ECFA), the CERN Accelerator School (CAS), the Institut National de Physique Nucleaire et de Physique des Particules (IN2P3), the Institut pour la Recherche Fondamentale/Commissariat a l'Energie Atomique (IRF/CEA) and the European Physical Society (EPS) was held at the Laboratoire de l'Accelerateur Lineaire (LAL), Orsay, from 29 June to 4 July 1987. Its purpose was to review current experimental and theoretical developments in charged-particle accelerator techniques and to address problems related to future very-high-energy machines. These proceedings contain the great majority of the papers presented at the Workshop, the corresponding questions and answers, and the round-table discussion. THe principal topics were semi-conventional high-frequency linacs, transformer acceleration mechanisms, acceleration using plasma, e^+e^- sources including low-emittance production and preservation, final focus and interaction point, and other new ideas. Among the latter were open accelerating structures, crystal X-ray accelerators, ferroelectrics, and acceleration using lasers. Separate abstracts were prepared for 29 papers in this volume of these proceedings.

18930 **(CERN—87-11-Vol.2) New developments in particle acceleration techniques, Volume 2: Proceedings.** Turner, S. (ed.). (European Organization for Nuclear Research, Geneva (Switzerland)). 12 Oct 1987. 366p. (ECFA—87/110-Vol.2; CONF-8706147—Vol.2). CERN, European Organization for Nuclear Research, CH-1211 Geneva, Switzerland. Order Number TI88900325/JAW.

From Workshop on new developments in particle acceleration techniques; Orsay, France (29 Jun 1987).

A Workshop organized jointly by the European Committee for Future Accelerators (ECFA), the CERN Accelerator School (CAS), the Institut National de Physique Nucleaire et de Physique des Particules (IN2P3), the Institut pour la Recherche Fondamentale/Commissariat a l'Energie Atomique (IRF/CEA) and the European Physical Society (EPS) was held at the Laboratoire de l'Accelerateur Lineaire (LAL), Orsay, from 29 June to 4 July 1987. Its purpose was to review current experimental and theoretical developments in charged-particle accelerator techniques and to address problems related to future very-high-energy machines. These proceedings contain the great majority of the papers presented at the Workshop, the corresponding questions and answers, and the round-table discussion. The principal topics were semi-conventional high-frequency linacs, transformer accelerator mechanisms, acceleration using plasma, e^+e^- sources including low-emittance production and preservation, final focus and interaction point, and other new ideas. Among the latter were open accelerating structures, crystal X-ray accelerators, ferroelectrics, and acceleration using lasers. Separate abstracts were prepared for 40 papers in this volume of these proceedings.

18931 **(CONF-871260—1) DOENEWS: Address of John S. Herrington, Secretary of Energy, at the National symposium on the superconducting super collider in Denver, Colorado, December 3, 1987.** Herrington, J.S. (USDOE Office of the Secretary, Washington, DC). Dec 1987. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003628/JAW.

From Symposium on the superconducting super collider; Denver, CO, USA (3 Dec 1987).

In this address, the President's support for basic science is briefly discussed, and support for the Superconducting Super Collider in particular is emphasized. Perceived benefits of the Super Collider are discussed, including benefits to the world, training for scientists, maintaining American competitiveness. Federal support of science, including Congressional action, is discussed briefly. (LEW)

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 18946, 19045, 19866, 20177, 20315, 20364, 20398, 20401, 20442, 20504, 20669

18932 **(FNAL-TM—1500) Radioactivation in "quiet" sections of the SSC [Superconducting Super Collider].** Cossairt, J.D. (Fermi National Accelerator Lab., Batavia, IL (USA)). Oct 1987. Contract AC02-76CH03000. 12p. (CONF-8710233—5). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005489/JAW.

From Meeting of the task force on radioactivation at the SSC; Berkeley, CA, USA (1 Oct 1987).

Estimation of induced radioactivity in the "quiet" sections of the SSC is approached using elementary methods. Estimates are given of total activity and residual dose rates on the surface of magnets in the quiet regions, as well as estimates of the activation of tunnel concrete. The residual radioactivity produced in the magnets and concrete walls of the "quiet" regions of the SSC are found to be quite small and of little radiological impact, but that simple scaling could yield results for more "lossy" regions. (LEW)

18933 **(FNAL-TM—1503) Evolution of the 400 MeV linac design.** MacLachlan, J.A. (Fermi National Accelerator Lab., Batavia, IL (USA)). 9 Nov 1987. Contract AC02-76CH03000. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005560/JAW.

The basic premises of the conceptual design for the linac upgrade are pursued to establish lengths, gradients, power dissipation, etc., for the 400 MeV linac and matching section. The discussion is limited to accelerating and focusing components. Wherever values depend on the choice of the accelerating structure, the disk-and-washer structure is emphasized; the results are generally relevant to the side coupled cavity choice also.

18934 **(LA—11130-C, pp 8-31) TRIUMF kaon factory proposal.** Craddock, M.K. (Univ. of British Columbia, Vancouver). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

The KAON Factory will provide 30 GeV protons with 100 μA currents - 80 times more intense than available at present and capable of producing correspondingly more intense, or cleaner, beams of secondary particles, particularly kaons, antiprotons and neutrinos. To accelerate a 100 μA beam from the TRIUMF cyclotron a chain composed of two fast cycling synchrotrons and three storage rings has been proposed. Various design features, such as H^- stripping injection, high transition energy and bucket-to-bucket beam transfer, will avoid or reduce beam loss. Recent design developments are summarized, including experimental work on rf cavities and successful demonstrations of the feasibility of extracting H^- ions from the cyclotron. Progress is also reported on the acceleration of polarized protons, the rf separation of kaon beams and on magnet design near production targets. The proposal received favorable technical and economic reviews during 1986. It is now being taken forward to the Canadian government with the strong backing of the Province of British Columbia.

18935 **(LA—11130-C, pp 32-66) European Hadron Facility.** Bradamante, F. (Universita di Trieste, Italy). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

The European Hadron Facility (EHF) is a new research facility for nuclear and particle physics which is proposed for Western Europe in the 1990's. It consists of a complex of accelerators to produce a high-intensity (100 μA) proton beam of 30 GeV kinetic energy, and is meant to provide a broad range of intense, high-quality secondary beams of neutrinos, muons, pions, kaons and antiprotons. A distinctive feature of this machine is that it has been designed to accelerate polarized proton beams to full energy.

18936 **(LA—11130-C, pp 67-88) Outline of the Japanese Hadron Facility.** Kihara, M. (National Lab. for High Energy Physics, Ibaraki, Japan). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

The Japanese Hadron Facility is a new research facility which is proposed for nuclear physics and materials science in 1990's. The conceptual design study is in progress. The outline of the project will be reported.

18937 **(LA—11130-C, pp 89-106) Status and performance of the KEK-PS.** Kihara, M.; Hiramatsu, S.; Kumagai, N.; Mori, Y.; Takasaki, E.; Yamane, I. (National Lab. for High Energy Physics, Ibaraki, Japan). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

The KEK Proton Synchrotron (KEK-PS) has operated for a decade for high energy physics and for the Booster Synchrotron Utilization Facility (BSF). In this report will be given the brief description of the present status and performance of the KEK-PS.

18938 **(LA—11130-C, pp 107-123) Kaon factories seen from the CERN PS.** Baconnier, Y. Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

The predictable losses of the Kaon factory are evaluated by comparison with CERN machines. The integrated dose to equipment (measured in rad or gray) and the radiation dose induced in the ring (measured in rem/h or Sievert/h) is estimated. The distribution of these doses is also predicted. Some of the consequences are described. In particular the electrostatic septa will be unable to stand the heat due to particle interaction. The obvious conclusion is that the main problem of Kaon factories will be to reduce the losses. An attempt is made to indicate possible subjects of R and D in order to achieve this aim.

18939 (LA—11130-C, pp 124-137) **BNL upgrade plans.** Foelsche, H.W.J. (Brookhaven National Lab., Upton, NY). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

Brookhaven National Laboratory is proposing two major upgrade projects for a future experimental program with protons and heavy ions. The first is the construction of a Relativistic Heavy Ion Collider (RHIC) which will use the AGS complex as an injector. The second initiative is an upgrade of the AGS proton intensity and duty cycle. Both objectives require a Booster for the AGS which has recently been approved as a construction project. With the completion of the booster, and with certain modifications of the AGS, the facility will ultimately become capable of supporting average proton currents on the order of 25-50 microamperes. The RHIC will provide center-of-mass collision energies of 2 x 100-125 GeV/amu for ions up to the heaviest masses, and 2 x 250 GeV for protons.

18940 (LA—11130-C, pp 138-140) **Advanced hadron facility: a combined kaon factory and cold-neutron source.** Thiessen, H.A. Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

The authors present a concept for an advanced hadron facility consisting of a combined kaon factory and second generation spallation source. Their concept consists of a 1.2 GeV superconducting H^- afterburner to bring the LAMPF energy up to 2 GeV, a multi-ring 2 GeV compressor, a shared cold-neutron and stopped-pion neutrino source, a 60 GeV 25 μAmp 6 Hz proton synchrotron, and kaon and proton experimental areas. The authors discuss the considerations which led to this concept. They summarize recent results of r & d work on components for rapid-cycling synchrotrons. Finally, they mention briefly the possibilities for a pion linac at LAMPF.

18941 (LA—11130-C, pp 198-207) **Power optimized design for the EHF 400 MHz drift tube linac.** Pabst, M.; Bongardt, K. (Kernforschungsanlage Juelich, West Germany). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

As a part of the European Hadron Facility (EHF) a 400 MHz drift tube proton linac has been designed. This linac accelerates a peak current of 50 mA from 2 MeV up to 150 MeV. The linac structure has been optimized to give a low power consumption or a short linac length. The beam dynamics in the linac is tested by multiparticle calculations including space charge. A choice of beam parameters is possible which give almost no transverse emittance increase. The longitudinal emittance increases by 20 to 30%.

18942 (SAND—88-0091C) **Design of electron beam accelerator for microwave application.** Prestwich, K.R. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 40p. (CONF-880149—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005252/JAW.

From Pulsed power short course; Lubbock, TX, USA (18 Jan 1988).

Relativistic electron beams are used for generating high power microwaves. These microwave sources require electron beam generators spanning significant ranges in voltage and impedance. The pulsed power technology used to generate these electron beams is presented. Electron beam generators that produce beams with pulse durations in the 10 ns to 100 ns regime consist of an energy storage section, pulse shaping section, and an electron beam diode. The energy storage section is either a Marx generator or capacitor bank-pulsed transformer. The pulse shaping is done with high-voltage transmission lines. The electron beam diode is usually a cold-cathode, space-charge-limited flow device. For longer pulses (~1 μs) the energy storage and pulse shaping can be combined. Lumped-element pulsed-forming networks (PFN) can be designed to produce the desired pulse shape. The Marx generator becomes one of the elements of the PFN. Alternatively, a low voltage PFN followed by a highly coupled transformer can be used. Basic design principles for all of the above subsystems are discussed. Both PFLs and PFNs can also be operated as inductive storage systems with opening switches.

18943 (SLAC/AP—61) **Comparison of two approaches to linear collider design.** Schnell, W. (Stanford Linear Accelerator Center, Menlo Park, CA (USA); European Organization for Nuclear Research, Geneva (Switzerland)). Nov 1987. Contract AC03-76SF00515. 8p. NTIS, PC A02. Order Number DE88003881/JAW.

This paper reviews linear collider parameters. It aims at analyzing two specific design approachs - the ones for CLIC at CERN and for a TeV linear collider at SLAC - which appear to lead into remarkably different directions although they start from the same premises and try to respect the same boundary conditions. 19 refs.

18944 **WNR/PSR facility - neutron physics capabilities from sub-thermal to 800 MeV.** Lisowski, P.W.; Wender, S.A.; Auchampaugh, G.F. (Los Alamos National Lab., NM, USA). *Radiation Effects;* No. 1-4, 239-251(1986). (CONF-850507—).

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

The Weapons Neutron Research facility (WNR) is a versatile pulsed neutron source used in a variety of research programs ranging from fundamental neutron properties with ultra cold neutrons to medium energy charge exchange reaction studies. The authors describe the WNR facility and the improvements presently in progress as the Proton Storage Ring (PSR) becomes operational.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 18943, 19567, 20402, 20403, 20405, 20406, 20407, 20408, 20409, 20410, 20411, 20412, 20415

18945 (AD-A—186066/7/XAB) **High-repetition-rate electron-beam rf-acceleration and submillimeter-wave generation via a free-electron laser. Annual progress report, 15 August 1986-14 August 1987.** Luhmann, N.C.; McDermott, D.B. (California Univ., Los Angeles (USA)). 14 Aug 1987. 18p. NTIS, PC A03/MF A01.

Short electron pulses can even enhance free-electron lasers gain. First-order effects become dominant as the spatial extent of the electron pulse becomes much shorter than the radio frequency wavelength. A buncher cavity between the electron gun and accelerator can improve the quality of the accelerated beam. The buncher has two adjustable parameters, the input power and its phase with respect to the accelerator. The input power determines the bunching parameter, which is a measure of the extent of bunching. The buncher cavity's phase controls the phase at which the electron pulses enter the accelerator and thus far their final energy. In any travelling-wave interactions, half of the beam gains energy while the other half loses energy. For synchronism of the beam with the wave, the two terms exactly cancel and there is no net power transfer. Energy loss dominates gain when the beam is properly mistuned from synchronism. The enhancement scheme for the cyclotron autoresonant maser, recognized as appropriate for any TWI, is to effectively suppress the electrons which are phased to

gain energy by using the gyro-resonant properties of a FEL wiggler. This enhancement wiggler is distinct from the FEL wiggler.

18946 (AD-A—186235/8/XAB) **High-midplane-accessibility stellarator windings for high-current toroidal accelerators. Memorandum report.** Marsh, S.J.; Golden, J.; Kapetanakos, C.A.; Anderson, D. (Naval Research Lab., Washington, DC (USA)). 6 Oct 1987. 33p. (NRL-MR—6025). NTIS, PC A03/MF A01.

Two strong-focusing field configurations were developed that provide high-midplane accessibility and, therefore, are compatible with presently contemplated extraction schemes for high-current, toroidal accelerators. When these windings are attached to a modified betatron accelerator, the bandwidth of the device is slightly smaller than the bandwidth of a modified betatron with unsplit stellarator windings. However, the bandwidth of the two new configurations is more than sufficient even for modest (20-30 kA) winding current.

18947 (DOE/ER/10569—5) **[Collective acceleration of electrons and ions in a high relativistic electron beam]: Progress report.** Nation, J.A.; Seyler, C.E. (Cornell Univ., Ithaca, NY (USA)). [1988]. Contract AC02-80ER10569. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005261/JAW.

This paper discusses progress in the acceleration of electrons and ions to high relativistic speeds. Most of the current research time has been spent in the development of a new pulsed power, low repetition rate source for electron wave acceleration. Other projects discussed are investigations in slow space charge waves, fast wave excitation and a phase slip accelerator concept. (LSP)

18948 (FNAL-TM—1495-Rev.) **Simulation of bunches coalescing in the main ring, in the presence of a high-frequency, wide-band resonator.** Garoby, R. (Fermi National Accelerator Lab., Batavia, IL (USA)). 4 Dec 1986. Contract AC02-76CH03000. 3p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88006253/JAW.

During the first part of the coalescing process, bunches are stretched until they fill a 1 kV 53 MHz bucket. It is considered likely that local instabilities developed in the bunch during manipulation. A computer calculation was done to give an approximate picture of the bunch distortions, and outputs are presented. The high frequency impedance seen by the beam was simulated by a Q = 1 resonator at 2000 MHz. Some simulations have also been done at the bunch rotation part of coalescing, and no catastrophic degradation was found. The bunch stretching part of the coalescing process is found to be sensitive to machine impedance. Bunch rotation is found to be more tolerant. (LEW)

18949 (FNAL-TM—1502) **Design of the D0 overpass dispersion correction.** Trbojevic, D. (Fermi National Accelerator Lab., Batavia, IL (USA)). 7 Oct 1987. Contract AC02-76CH03000. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005488/JAW.

The existing D0 overpass induces a vertical dispersion wave around the Main ring with dispersion amplitudes of around 1.6 to 1.8 m. There are two major reasons to eliminate or reduce vertical dispersion induced by the D0 overpass: to lower the beam momentum dependence on vertical positions which had not existed before the overpass; and to raise the Tevatron luminosity by eliminating the dispersion mismatch between the main Ring and Tevatron. 20 figs., 1 tab.

18950 (FNAL-TM—1504) **Debunching into a bucket of lower harmonic number.** MacLachlan, J.A.; Griffin, J.E. (Fermi National Accelerator Lab., Batavia, IL (USA)). 9 Dec 1987. Contract AC02-76CH03000. 13p. NTIS, PC A03. Order Number DE88005558/JAW.

The adiabatic debunching of beam from buckets of higher harmonic number into waiting buckets of lower harmonic number is a critical step in the current scheme of operation for Tev I. The optimum choice of rf system parameters for this "bunch coalescing" process is not immediately obvious. In this note two examples are presented along with generalizations based upon them and experience with the Tevatron I design which can simplify the selection of appropriate parameters for different conditions.

18951 (LA—11130-C, pp 210-220) **Coupled bunch instabilities in kaon factory synchrotrons.** Baartman, R. (TRIUMF, Vancouver, British Columbia). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

Synchrotrons for kaon factories will not necessary break new ground in terms of instabilities: high average beam intensity is attained by rapid cycling rather than by a high circulating current. As compared with the CPS or the AGS, the rapid-cycling nature impacts upon kaon factory synchrotrons in two ways. (1) There is more total impedance due to rf cavities, so that both the number of cavities and their individual impedances should be minimized. (2) The beam pipe impedance needs to be large to minimize eddy currents. This exacerbates the resistive wall effect unless the beam pipe is constructed of an insulator with a thin highly conductive coating.

18952 (LA—11130-C, pp 221-236) **H^- injection for the TRIUMF kaon facility.** Mackenzie, G.H. (TRIUMF, Vancouver, British Columbia). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

TRIUMF proposes to construct a KAON Factory based on the acceleration of 100 μA of protons from 0.45 to 30 GeV by means of two synchrotrons. The first, the Booster synchrotron, would operate at 50 Hz and would be filled with protons accumulated in a storage ring of the same size and located in the same tunnel. This Accumulation ring in turn will be filled by protons injected continuously over $\sim$ 20 ms by stripping H^- ions extracted from the TRIUMF cyclotron. Analytic calculations and a simulation program show that such accumulation is feasible and that a beam for Booster injection may be prepared by suitably programming changes in injected beam parameters and ring closed orbit position during injection. Such a technique should allow stripper lifetimes of several hours. The simulation program has also been used for brief studies on acceleration and on internal targets. The cyclotron must be modified to provide extracted H^- beams. A program has started and electrostatic deflector efficiencies of 85% have been measured with beams of 20 μA equivalent current.

18953 (LA—11130-C, pp 279-281) **Transmission-line impedance measurements of beam pipes for an Advanced Hadron Facility.** Walling, L.; Neuffer, D.; Thiessen, H.A.; Spalek, G. Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

An Advanced Hadron Facility (AHF) requires a beam pipe with low eddy-current losses and a low beam-coupling impedance. The requirements cannot be met with a solid, conducting beam pipe but may be met by a ceramic pipe with conducting layers, which may have a higher coupling impedance. They have measured and compared the transmission-line impedances for several candidate pipe segments. The results are correlated with the beam-coupling impedance and are compared with calculated values and with AHF requirements.

18954 (LA—11130-C, pp 284-294) **Polarization capabilities of the European Hadron Facility.** Bluem, P.; Pisent, A. (Universitaet Karlsruhe, West Germany). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

The ability to accelerate polarized protons up to the final energy is one of the main objectives of EHF and strongly influences, together with the requirements of beam stability and minimum beam losses, the design of the accelerator complex. In particular the transfer energy between Booster and Main Ring has been selected to enable the use of Siberian Snakes as a global cure of resonant depolarization in the Main Ring.

18955 (LA—11130-C, pp 295-301) **Acceleration of polarized protons in AHF.** Colton, E.P. Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

In this paper the author performs an analysis of the depolarization expected during acceleration from 0.8-45.0 GeV kinetic energy in the Advanced Hadron Facility (AHF) accelerators. This work parallels closely the treatment in the LAMPF II proposal. The depolarization mechanisms are taken to be the so-called (i) intrinsic and (ii) imperfection resonances. These resonances are expected when the spin tune nu/sub sp/ assumes certain values. The spin tune nu/sub sp/ = Gγ where G is the anomalous magnetic moment (1.7928 for protons) and γ is the ratio of the particle total to rest mass energy. The intrinsic resonances occur for nu/sub sp/ = mS +/- nu/sub y/ where m is a positive integer, S is the machine superperiodicity, and nu/sub y/ is the vertical betatron tune. The imperfection resonances occur when nu/sub sup/ is integral. The physics and treatment are well documented.

18956 (LA—11130-C, pp 302-313) **Polarized beam at the AGS (performance and pitfalls).** Ratner, L.G. (Brookhaven National Lab., Upton, NY). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

A brief description of the conventional correction of intrinsic and imperfection resonances will be given, but the intent of this paper is to present some unexpected behavior when these conventional techniques were applied.

18957 (LA—11130-C, pp 317-320) **Test of the Siberian Snake concept at the IUCF cooler ring.** Roser, T. (Univ. of Michigan, Ann Arbor). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

The low energy IUCF proton cooler ring offers the unique possibility for an inexpensive and comprehensive proof of principle test of the Siberian Snake concept. If this test is successful, Siberian Snakes can be used in future high energy accelerators to eliminate depolarizing resonances.

18958 (LA—11130-C, pp 321-326) **Polarized protons in the TRIUMF KAON factory.** Wienands, U. (TRIUMF, Vancouver, British Columbia). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

In the following paper, methods for acceleration of polarized protons in the proposed TRIUMF-KAON Factory without too much depolarization are examined. Two ways of improving polarization transfer will be treated: passing through depolarizing resonances using either fast tune shifts or slow adiabatic spin flip, and reducing the strength of depolarizing resonances by redesigning the lattice using spin matching. It is shown that a combination of the two methods can result in about 70% polarization transfer through the accelerators, providing about 55% polarization of 30 GeV protons.

18959 (LA—11130-C, pp 327-332) **Siberian Snakes for the TRIUMF KAON factory.** Wienands, U. (TRIUMF, Vancouver, British Columbia). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

The feasibility of incorporating Siberian Snakes into the Driver ring of the proposed KAON Factory is investigated. Due to the relatively low injection energy of 3 GeV, chosen for maximum cost efficiency, orbit distortions in the snake magnets tend to be unacceptably large. Novel designs, however, like the helical snake or the discretized helix proposed here, promise reduced orbit excursions that are further reduced by using superconducting magnets with a field of 3 T. In this way, orbit excursions are reduced to a few cm as opposed to several tens of cm. Systematics of these designs are investigated and the insertions necessary for the lattice are discussed. It is shown that incorporation into the lattice can be achieved without undue distortion of the lattice functions.

18960 (NIIEFA-P-V—0736) **Application of the large particle method for calculating beam dynamics in an induction linear accelerator.** Tikhomirov, A.S. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1986. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701527/JAW.

Algorithm and the PL/1(0) program for analyzing parameters of high-current pulse beam in an induction linear acceleration has been developed. Calculation of eigenfields of the beam is conducted in coordinate system, moving together with each large particle. Earlier calculated table of the Green function for field intensity are used at that. Accelerating voltage pulses are given by the table on time. Large particle parameters in injection plane can change depending on energy. External magnetic fields on axis or in grid nodes where all external and eigenfields of the beam are calculated are given in the table. 8 refs.; 3 figs.

18961 (SLAC-PUB—4441) **Wakefields of very short bunches in an accelerating cavity.** Bane, K.; Sands, M. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Nov 1987. Contract AC03-76SF00515. 21p. (CONF-8708177—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004629/JAW.

From Workshop on impedance beyond cutoff; Berkeley, CA, USA (18 Aug 1987).

The behavior of the longitudinal and transverse wakefields of short bunches in an accelerating cavity has been examined. Computations of short time wakefields have been carried out using T. Weiland's computer program TBCI, which integrates Maxwell's Equations in the time domain. We present also our version of the diffraction model of the high frequency impedance of the cavity, a model originally suggested by Lawson. This model predicts a longitudinal impedance that varies as ω/sup -1/2/ and a transverse impedance that varies as ω/sup -3/2/ at high frequencies, with their ratio equal to $\omega a^2/(2c)$, where a is the radius of the beam tube. We find that as shorter bunches are used, the computations approach asymptotically the predictions of the diffraction model. 14 refs., 11 figs.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 18856, 18952, 18953, 18954, 19567, 19771, 20263, 20404, 20413, 20414, 20689

18962 (FEI—1684) **Device for stabilization of resonance frequency of dee circuit and voltage symmetry on cyclotron dees.** Biryukov, N.S.; Zhuravlev, B.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703151/JAW.

A device permitting to tune automatically the dee circuit of a cyclotron in resonance with accelerating voltage and to eliminate asymmetry of voltages on the dees is described. The device comprises systems of automatic tuning of dee circuit resonance frequency and voltage symmetry control on dees, which are closed-circuit systems of linear regulation. Both systems are similar in their structure except for transducers: for the first one phase detector is used, for the second one the transducer is connected in the voltage comparator circuit. The device restores the assigned regime after a long-time shutdown of a cyclotron with considerable accuracy. 1 reference, 2 figures.

18963 (FNAL-TM—1494) The magnetic properties of the SLC intersection region superconducting quadrupole triplets. McInturff, A.D.; Carson, J.A.; Fisk, H.E.; Erickson, R.A. (Fermi National Accelerator Lab., Batavia, IL (USA); Stanford Linear Accelerator Center, Menlo Park, CA (USA)). 25 Sep 1987. Contract AC03-76SF00515;AC02-76CH03000. 5p. (CONF-870901—18; SLAC-PUB—4478). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003971/JAW.

From 10. international conference on magnet technology (MT-10); Boston, MA, USA (21 Sep 1987).

The measured magnetic field parameters of the quadrupoles which comprise the final triplet lens system for the SLAC Linear Collider intersection region are presented here. The minimum design gradient specifications for these quadrupoles are 1.7T/cm at 4.6K and 1.6T/cm at 4.6K in a 0.6T external solenoidal field. These gradients are about three times larger than those available with the conventional iron/copper quadrupoles now used in the SLC. Superconducting quadrupoles of two lengths have been specified for the SLC triplets. The effective magnetic length of type Q_1 is 66.498 +- 0.305cm and of Q_2 is 121.106 +- 0.61cm. The superconducting performance characteristics of the quadrupoles that have been measured are: maximum critical current as a function of bath temperature, rate of change of magnetic field, and as a percentage of the "short sample". "Short sample" performance is defined as the current reached by the cable in a perpendicular magnetic field equal to the peak field in the winding at bath temperature. The maximum gradient achieved during testing was 2.04T/cm (4.25K) and 2.07T/cm (3.2K). This represented 95% of the strand critical current value. The magnetic length of the first Q_2 was measured to be 120.85 +- .1 cm. The Fourier harmonic coefficients of the magnetic field were measured as a function of current and are reported. 3 refs., 5 figs., 7 tabs.

18964 (FNAL-TM—1507) Design note of an air-cooled 2 ft x 2 ft x 10.5 ft long muon spoiler. Visser, A.; Pathiyil, J. (Fermi National Accelerator Lab., Batavia, IL (USA)). 6 Jan 1988. Contract AC02-76CH03000. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005557/JAW.

This note describes the construction of a muon spoiler (magnetized steel assembly) with a cross section of 2 ft by 2 ft and a length of 10.5 ft. Two such spoilers are operated in series at an average field of about 15 kGauss, from one 100 ADC, 40 V power supply. The purpose of the spoilers is to prevent muons from easily escaping beyond the muon laboratory experimental area by bending them down so that they have to pass through more earth. The spoilers reduce the muon dose rate beyond the experimental area by about a factor of 15 to 20. These types of spoilers are not precision devices. They were inexpensive to build from scrap materials using rough flame cutting methods. It took about 14 days to fabricate them.

18965 (IFVE-OMVT—85-24) Algorithm for solution of nonsymmetric generalized problem of eigenvalues. Anikeeva, V.A.; Fedoseev, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703232/JAW.

The solving of electrodynamic problems, appearing when developing accelerating structures results in algebraic eigenvalue problem. The same problems arise when solving bound states in elementary particle physics. A method to solve asymmetric generalized algebraic eigenvalue problem $AX=BX\Lambda$, based on the use of B-orthonormal basis, is suggested. The program realizing the method is presented. The method possibilities are demostrated for a number of examples. 7 references.

18966 (IFVE-OMVT—85-26) Heat regime calculation of accelerating structure for continuous-action racetrack microtron. Abramov, A.G.; Grishin, V.K.; Dajkovskij, A.G.; Ershov, S.Yu.; Ishkhanov, B.S.; Shvedunov, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703233/JAW.

The necessity to study thermal conditions of accelerating structures operating in a continuous regime is conditioned by a high level of HF losses (10-30 kW/m at the field gradient 0.5-1.5 MeV/m in the frequency range 2450 MHz). The heat regime of accelerating structures which is the basis of a racetrack microtron is investigated. Calculations of temperature fields and deformations of omega-structure with internal coupling cells and dise-loaded structures are presented. The dependence of the structure characteristics on heat regime is studied. 8 references, 8 figures.

18967 (IFVE-OMVT/OUNK—86-201) Simulation of two-dimensional non-stationary temperature fields in UNK superconducting magnets. Abramov, A.G.; Ageev, A.I.; Baluev, A.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703234/JAW.

Methods of the non-stationary temperature field calculation in the cross section of the UNK superconducting (SC) dipole magnet with cold yoke for the cooling and warming up is presented. The problem is solved by the finite elements method with account for the pressence of thermal resistance between element of magnet. Calculational and experimental results for the module imitating the SC magnet cross section are compared. 9 references, 6 figures.

18968 (LA—11130-C, pp 340-341) Los Alamos ferrite-tuned cavity. Carlini, R.D.; Friedrichs, C.C.; Spalek, G.; Smythe, W.R. Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

An rf accelerating cavity appropriate for use in a 20% frequency bandwidth synchrotron has been designed, fabricated, and is now being tested at Los Alamos. The cavity-amplifier system was designed to produce a peak rf gap voltage of 90 kV over the range from 50 to 60 MHz. Special features of the system are the transversely biased ferrite tuner, capacitive coupling of the amplifier to the cavity, and a 15-cm beam pipe. High-power rf testing of the cavity-amplifier system started in August 1986, using an adjustable dc power supply to bias the ferrite. This paper describes the cavity-amplifier circuit and the test results to the present time. Future plans are also discussed.

18969 (LA—11130-C, pp 342-348) RF cavity design for the EHF booster. Griffin, J.; Massarotti, A.; Puglisi, M.; Shaffer, G. (Fermi National Lab., Batavia, IL). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

The European Hadron Facility (EHF) is presently proposed to consist of a 1.2 GeV Linac feeding a 25 Hz 9 GeV Booster followed by a 12.5 Hz 30 GeV main Ring. The Booster and the Main Ring each have an additional fixed energy ring (Holding Ring and Stretcher) so that a continuous 100 A beam of protons can be produced. Each ring will require a substantial rf system operating near 53 MHz. Because of the significant frequency swing required, the Booster rf system appears to be the most technically demanding. Boundary conditions and rf requirements are outlined. During November of 1986, a short design workshop was held and a proposed design for a prototype development rf cavity was produced.

18970 (LA—11130-C, pp 349-358) Drive stage for cathode follower rf system. Irie, Y. (National Lab. for High Energy Physics, Ibaraki-ken, Japan). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

Method to provide a wideband and high gain drive stage of cathode follower system is studied by a simple model. The m-derived bridged-T network is found to be the most efficient scheme. The advantage of cathode follower, i.e. low output impedance is never lost by this installation.

18971 (LA—11130-C, pp 359-365) **Status of rf development work on a ferrite tuned amplifier cavity for the TRIUMF KAON factory booster ring.** Poirier, R.L.; Enegren, T. (TRIUMF, Vancouver, British Columbia). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

Of the five synchrotron rings in the proposed TRIUMF KAON factory, the Booster ring to accelerate the proton beam from 440 MeV to 3 GeV has the most demanding rf requirements, primarily because of the relatively large frequency swing of 46.1 MHz to 61.1 MHz at a high repetition rate of 50 Hz. In the current reference design, the Booster lattice has twelve 3.9 m drift spaces with 2.5 m in each drift space available for installation of rf cavities to provide a required effective acceleration voltage of up to 600 kV per turn i.e. 50 kV per cavity. Design and development studies of a suitable cavity-amplifier system are in progress. For the initial reference design a system based on the one used in the Fermilab booster synchrotron has been chosen. That is, a double-gap drift-tube cavity with parallel-biased ferrite tuners and excited with a directly coupled Eimac Y567B tetrode. To meet the tuning and voltage requirements within the various mechanical and other constraints such as tube-to-gap voltage ratio, ferrite power density and available space, the reference design had to be further modified and a cold model of the cavity and tuners was constructed from copper-covered cardboard cylinders. From the results of the cold model measurements a new reference design was established and design work has begun on a full power prototype of the cavity-amplifier system.

18972 (LA—11130-C, pp 366-370) **Comments on the beam-cavity stability problem as it affects rf system requirements.** Smythe, W.R. (Univ. of Colorado, Boulder). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

The author discusses beam loading effects on the proposed ferrite-tuned rf system. The show that fast feedback can stabilize the system without resorting to intentionally reducing the cavity Q.

18973 (LA—11130-C, pp 381-388) **Power supply design for hadron facility.** Karady, G.; Kansog, J.; Thiessen, H.A.; Schneider, J. (Ebasco Services). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

Recently, a study investigated the feasibility of building a large 60 GeV kaon factory accelerator. This paper presents the conceptual design of the magnet power supplies and energy storage system. In this study the following three systems were investigated: (a) power supply using storage generator; (b) power supply using inductive storage device; (c) resonant power supplies. These systems were analyzed from both technical and economical points of view. It was found that all three systems are feasible and can be built using commercially available components. From a technical point of view, the system using inductive storage is the most advantageous. The resonant power supply is the most economical solution.

18974 (LA—11130-C, pp 389-394) **Preliminary design of A.C. quadrupole magnets for an Advanced Hadron Facility synchrotron.** Liu, J.; Greene, S.; Hunter, T. Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

Preliminary design of the A.C. quadrupole magnets is reported for an Advanced Hadron Facility (AHF) 45 GeV synchrotron. Magnet configurations with hyperbolic pole shapes are determined by means of computer aided design. Magnetic field distributions and harmonics analyses are given, and basic design parameters of the quadrupoles are presented.

18975 (LA—11130-C, pp 395-401) **Preliminary investigation and design of an A.C. dipole magnet for an advanced hadron facility synchrotron.** Liu, J.; Greene, S.; Hunter, T. Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

In this paper, preliminary design of an A.C. dipole magnet is reported for an Advanced Hadron Facility (AHF) 45 GeV synchrotron. Magnet configuration with additional adjustment coils is determined by means of computer aided design. A maximum field intensity of 1.5 Tesla with +/- 0.01% uniformity can be obtained, and it can be increased to 2.0 Tesla as synchrotron energy upgrades to 60 GeV in the future. Eddy current effects and possible damages to coils are taken into account.

18976 (LA—11130-C, pp 402-407) **Dual frequency resonant magnet excitation.** Reiniger, K.; Lacey, W.K. (TRIUMF, Vancouver, British Columbia). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

This paper deals with the magnet system envisaged for the TRIUMF KAON factory. It covers some of the design considerations resulting in the final choice of dual frequency resonant magnet excitation as well as the presentation of a preliminary design for a capacitor switch.

18977 (LA—11130-C, pp 408-422) **Performance of prototype rapid cycling magnet and power supply for KEK GEMINI project.** Sasaki, H.; Someya, H.; Adachi, T.; Sakai, I.; Nakanishi, M. (National Lab. for High Energy Physics, Ibaraki-ken, Japan). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

A prototype magnet and its power supply of a high intensity proton synchrotron for condensed matter research have been constructed. Investigations have been focused on the behaviors of the system in rapid-cycling operation. This paper reports some operational experiences and performance of the system.

18978 (LA—11130-C, pp 423-429) **Dual frequency resonant power supply system experimental results.** Schneider, E. Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

This paper will describe the experimental results obtained from a model of a dual frequency resonant power supply system that maintains flat bottom and flat top currents in the magnet. Two methods of injecting energy into the system so as to replace circuit losses are shown. The model is operated in a single pulse mode first and then operated in a repetition rate mode to observe the effects on the magnet flat bottom and flat top currents.

18979 (NIIEFA-P-E—0745) **Magnet structure of a heavy ion synchrotron.** Belov, V.P.; Kazarinov, N.Yu.; Mikhajlov, V.A.; Nagaenko, M.G.; Perel'shtejn, Eh.A.; Shukejlo, I.A. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1986. 18p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701524/JAW.

Results of calculating magnet system of a heavy ion synchrotron (HIS) are presented. The system is charaterized by application of magnet elements, similar to earlier developed ones for the IHEP boosters. They enable to store of the order of 10/sup 10/ ions of U/sub 238//sup 80/ and 6x10/sup 10/ light nuclei in a pulse and accelerate them up to the energies of 300 and 600 MeV/nucleon respectively under conditions of slow beam extraction or 400 and 800 MeV/nucleon under conditions of fast beam extraction. The KVTI-20 collective accelerator is considered as the HIS injector. Injection of five bunches of ions with the 20 MeV/nucleon energy and pulse - frequency of 50 Hz is provided. The frequency

of HIS cycle can change from 1 up to 3 Hz. Magnet structures of two types - triplet and FODO - were analyzed during HIS development. The triplet version is prefered, because it enables to use completely earlier developed irregular magnet elements. The perimeter of the HIS magnet structure is equal to 154.56 m; it consists of 16 periods, each including 2 bending, 2 focusing and 1 defocusing units. Conducted calculations show, that the region of tetatron oscillation frequencies with account for correction is characterized by the fact, that it is not crossed by resonance lines up to the 4th order inclusively, passing in the vicinity of the operation point. Amplitudes of betatron oscillations near resonances suffer pulsations, which result to undesirable growth of effective beam emittance. 9 refs.; 7 figs.; 2 tabs.

18980 **(SLAC-PUB—4520) Two solutions for damping ring extraction kicker for Elisa.** Odian, A. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Jan 1988. Contract AC03-76SF00515. 3p. (CONF-871261—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005776/JAW.

From Workshop on B-meson factory; Courmayeur, Italy (14 Dec 1987).

A ferrite magnet and a no-ferrite solution is found for the design of a damping ring extraction kicker. (LEW)

18981 **Uhv linear actuators for NSLS beam lines.** Oversluizen, T. (Brookhaven National Lab., Upton, NY, USA). *Vacuum;* **38**: No. 1, 27-30(1988).

Linear actuators used for beam line operations in the National Synchrotron Light Source are described. The standard model, many of which are built and in use, is outlined. Details are given of some more recent developments in this field.

18982 **Direct recovery of ion beam energy using magnetic electron suppression. Pt. 1. Analysis of ORNL energy recovery experiments.** Ryan, P.M.; Stirling, W.L.; Whealton, J.H.; Alexeff, I. (Oak Ridge National Lab., TN, USA; Tennessee Univ., Knoxville, USA. Dept. of Electrical Engineering). *Nuclear Instruments and Methods in Physics Research;* **261**: No. 3, 556-572(15 Nov 1987). Contract AC05-84OR21400.

The charge-exchange neutralization efficiency of positive ion-based neutral beams used in plasma heating applications decreases as the beam energy increases. Direct energy recovery from the remaining charged particles can be accomplished by electrostatically decelerating the positive ions; the space-charge neutralizing electrons are constrained from being accelerated by the application of a transverse magnetic field. A finite difference nonlinear sheath analysis is used to analyze the transverse magnetic field electron suppression experiments carried out at Oak Ridge National Laboratory in the early 1980s. A double plasma model, which assumes an equilibrium Boltzmann distribution of electrons at both the neutralizer potential and the ion collector potential, is used to study the experimental data obtained from operating 40 keV, 10 A ion beam energy recovery experiments. The effects of the magnetic field strength, ion 'boos' energy, and ion beam current density are examined in detail.

18983 (LA—11130-C, pp 333-337) **Optically pumped polarized ion sources for LAMPF.** York, R.L.; Dulick, M.; Cornelius, W.D.; van Dyck, O.B. Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

The status of the three operational optically pumped polarized H^- sources is reviewed. The optically pumped polarized H^- source development program at LAMPF is discussed. Aspects of this type of source requiring further research and development are discussed.

18984 **(NIIEFA-P-V—0722) MESHWORK-1 program computer for analysis of high-perveance beam parameters in thermionic systems.** Tikhomirov, A.S. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1986. 14p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701526/JAW.

FORTRAN-program complex for calculation of high-perviance beam parameters in the axially symmetric systems with a thermocathode is developed. The outline of electrodes is a set of line segments and arcs of a circles with prescribed values of potentials. The Laplace differential operator is replaced by a finite-difference one with O(h/sup 2/) error. Calculation of charge density distribution is carried out on the basis of trajectory analysis. The magnetic self-field of a beam is calculated according to the law of full current. The MESHWORK-1-program complex developed allows quickly and with sufficient for practice accuracy to calculate electron beam injection parameters for high-perviance linear accelerator guns. 6 refs.

18985 **(SLAC-PUB—4484) Positrons for linear colliders.** Ecklund, S. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Nov 1987. Contract AC03-76SF00515. 13p. (CONF-840873—9). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005779/JAW.

From US summer school on high energy particle accelerators; Batavia, IL, USA (13 Aug 1984).

The requirements of a positron source for a linear collider are briefly reviewed, followed by methods of positron production and production of photons by electromagnetic cascade showers. Cross sections for the electromagnetic cascade shower processes of positron-electron pair production and Compton scattering are compared. A program used for Monte Carlo analysis of electromagnetic cascades is briefly discussed, and positron distributions obtained from several runs of the program are discussed. Photons from synchrotron radiation and from channeling are also mentioned briefly, as well as positron collection, transverse focusing techniques, and longitudinal capture. Computer ray tracing is then briefly discussed, followed by space-charge effects and thermal heating and stress due to showers. (LEW)

18986 **(TRI—86-2) Proceedings of the workshop on the production and transport of secondary beams at a KAON factory.** Gill, D.R. (ed.). (TRIUMF, Vancouver, British Columbia (Canada)). Dec 1986. 179p. (CONF-8606128—). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88900349/JAW.

From Production and transport of secondary beam at a kaon factory workshop; Vancouver, B.C., Canada (1 Jun 1986).

Separate abstracts were prepared for 20 papers in these workshop proceedings. (LEW)

18987 **(IFVE-OEA—86-108) Controlled scale amplifier of signals from detectors of extracted proton beam intensity.** Dyshkant, A.S.; Krendelev, V.A.; Uglekov, V.Ya. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703206/JAW.

Submitted to the journal Instrum. Exp. Tech.

An amplifier designed for the operation in the monitoring system of extracted proton beam when measuring intensity in the range from $3x10^6$-$5x10^{12}$ protons/s is described. The range of measured charges is $5x10^{-13}$-$5x10^{-8}$ deg C. The transformation coefficient is established with an accuracy of 0.5% by means of a computer or manually with relative change 1:2:5:10:20:40:100. The amplifier comprises an input cascade and a controlled integrator made with the help of operational amplifiers with input field-effect transistors. Four chambers with massive and grid electrodes were used as detectors. Two operation modes were envisaged: ionization made at the intensity less than 10^9 protons, secondary emission made at the intensity higher than 10^9 protons. The preservation of metrological amplifier characteristics in a wide range of beam intensity permitted to improve measurement accuracy and made it possible to perform absolute calibration of instrumens for measurement of intensity during fast extraction of a beam from an accelerator. 9 references, 2 figures.

18988 **(IFVE-OEA—86-180) Wide-range monitor of fast extracted beam intensity.** Makonin, S.V.; Petrenko, S.V.; Seleznev, V.S.; Terekhov, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703207/JAW.

The development results of the wide-range (10^{10}-$5x10^{13}$ protons) fast ejected beam monitor - IHEP booster, are given. The oscillating mode current transformer is used as a monitor. The required precision is +-(1.0+10^{11}/I/sub p/)%, where I/sub p/ - the beam intensity. The system considered provided fast extracted beam intensity measurement during operation on SKAT, SIM installations and neutrino calorimeter. Besides it is applied for calibration of the secondary emission chambers aimed at measuring slow extracted proton beam intensity. 9 references, 7 figures, 1 table.

18989 **(IFVE-OKU—85-78) Parallel operation of three internal targets of the IHEP proton synchrotron.** Aseev, A.A.; Grishin, V.N.; Zelenov, B.A.; Medvedev, V.A.; Neushkin, A.A.; Sychev, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703231/JAW.

Mutual effect of local distortions of closed orbit (bumps) and coordinate ranges of steady beam guidence onto targets of three channels in case of their simultaneous operation is investigated. Using an auxiliary bump, practically initial range (as in the operation of two targets) of their operation coordinates for any three simultaneously operating channels, as well as in case of their successive operation with fast or slow extraction on the flat top of magnetic cycle, is ensured. Compensation of beam betatron oscillation frequency shifts due to the joint effects of bumps and decrease in monitor sensitivity to the operation of alien targets permitted to improve beam stability during its guidence onto three targets at once. The effect of FES kicker-magnet on the improvement of time structure of extracted particles is investigated. Depending on the target operation conditions the quality of dump structure is improved by a factor of 2-4. 9 references, 6 figures.

18990 (LA—11130-C, pp 184-197) **2.5 MeV low energy and the 1.2 GeV high energy transfer lines for the EHF accelerator complex.** Bongardt, K.; Pabst, M.; Wagner, M. (Zentralinstitut fuer Elektronik, Juelich, West Germany). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

The injection linac of the EHF accelerator complex has two complicated transfer lines: the 2.5 MeV transfer line between a 400 MHz RFQ and a 400 MHz DTL and the 1.2 GeV transition line between a 1200 MHz side coupled structure and the booster ring. In the 2.5 MeV line a 50 cm long fast chopping element has to be installed. Due to the 50 mA peak current of a 400 MHz bunched beam this line is space charge dominated which means severe space restrictions for the optical elements. Results are presented for a complete design with discrete conventional transport elements. For injecting the beam at 1.2 GeV into the booster a longitudinal painting process is foreseen which requires a small energy spread of the linac beam. For doing so bunching cavities with a total voltage of about 20 MV have to be installed in the transfer line between the linac and the booster. First results are given for an optimum position of these cavities.

18991 (LA—11130-C, pp 441-446) **Slow extraction from the KAON factory extender ring.** Wienands, U. (TRIUMF, Vancouver, British Columbia). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

The Extender ring for the proposed KAON Factory at TRIUMF will employ 1/3-integer resonant extraction to spill out the protons slowly and provide experiments with a continuous beam. An array of sextupoles is provided to selectively excite the 3 nu/sub x/ = 34 stopband without disturbing the vertical motion of the beam. A combination of electrostatic and magnetic septa will guide the extracted beam into the beamline. Chromatic extraction, using the natural chromaticity of the ring to shift the tune towards the resonance, or achromatic extraction from a chromaticity-corrected machine using tune-shift quadrupoles, can be used to drive the particles into instability. Results of tracking studies show that by achromatic extraction an extracted emittance of less than 1 π mm-mrad can be achieved.

18992 **(BNL—40633) Experience with synchrotron radiation sources.** Krinsky, S. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 6p. (CONF-8708180—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005610/JAW.

From Symposium on X-ray microscopy; Upton, NY, USA (31 Aug 1987).

The development of synchrotron radiation sources is discussed, emphasizing characteristics important for x-ray microscopy. Bending magnets, wigglers and undulators are considered as sources of radiation. Operating experience at the national Synchrotron Light Source on the VUV and XRAY storage rings is reviewed, with particular consideration given to achieved current and lifetime, transverse bunch dimensions, and orbit stability. 6 refs., 3 figs.

18993 **(FEI—1803) Temperature control of target surfaces.** Mironov, V.N.; Krasnov, N.N.; Konyakhin, N.A.; Ivanov, V.S.; Aleshchenkov, V.B.; Vdovenko, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703169/JAW.

Determination of optimal temperature regime for target irradiation appears to be one of the important problems, arising during radionuclide production in the cyclotron. System for measuring infrared radiation of the surface of targets under their irradiation in the cyclotron is described. The system comprises an inlet chamber unit; IR radiation signal measuring unit and IR radiation receiver position registers. Relation, for the target surface temperature and the infrared radiation receiver signal value is obtained. Experimentally produced dependences of cyclotron target maximum temperature on the charged particle beam power and temperature distribution on the surface are presented. It is shown, that under real conditions of radionuclide production in a cyclotron it is possible to exercise control over the target irradiated substance state and temperature; to actively interfere with the irradiation process; to exclude spraying and damaging of this substance and to carry out irradiation procedure at maximum permissible dose rate. 2 references, 8 figures.

18994 **(IAE—4080/7) Inverse problems of high-current electronics.** Abakumov, A.I.; Dolgachev, G.I.; Zakatov, L.P.; Oreshko, A.G.; Pikalov, V.V.; Skoryupin, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703171/JAW.

During electron beam impinge on taget a powerful continuous bremsstrahlung (B) is generated. The study of spectral composition of B is of great importance when investigating dynamics in diodes of high-current electron accelerators. Using absorbers and semiconductor detectors B absorption curves are obtained. It is shown that the problem of B spectral power determination is reduced to the Fredholm integral equation of the first type, and the problem of function reconstruction of electron beam energy distribution - to integral equation of convolution type. To obtain absorption curves the method of absorbers was used. For numerical solution of the Fredholm equation of the first type the iterative method was used. The reconstruction of energy distribution function of electron beam was realized using the developed method of inverse linear superposition. B spectra in the absolute units with a high time resolution are measured. Electron beam energy distribution functions are reconstructed. 13 references, 9 figures.

18995 (IFVE-OEA—85-2) **Microprocessor devices for automated setups of high energy physics.** Govorun, V.N.; Davidenko, A.M.; Dantsevich, G.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703205/JAW.

The set of electronic modules on the base of the K580 integrated circuit family and used for building automated systems at IHEP is described. A brief description of the software for the modules is given. Some automated systems using the described modules which provide solutions of different problems of the data acquisition and processing in physical experiments and also the control of experimental equipments are considered. 9 references, 4 figures.

18996 (LA—11130-C, pp 141-155) **Present status and upgrade plans for ISIS.** Gray, D.A. (Rutherford Appleton Lab., Didcot, England). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

ISIS, the spallation neutron source, has run for neutron scattering research for extended periods during the last year. It has run regularly with a mean current of 28-32 μA at 550 MeV. Efficiencies of transmission of the beam from injector through the synchrotron to the neutron production target have been good. The system for collecting beam lost in the synchrotron is working well. Modifications are in hand in the present shut-down to increase the proton energy to its design 800 MeV and to increase the current from its present 15% of design to 200 μA mean. Under the umbrella of a Memorandum of Understanding signed by Ministers from France, Italy, Sweden and the UK an International ISIS Project Group with members from the above countries and others has produced a technical report with various costed options for development of ISIS beyond its present specification. Following appraisal by the International Science Advisory Group this report is expected to form the basis of the presentation to Governments proposing a fully international ISIS program.

18997 (LA—11130-C, pp 156-168) **EURAC: a concept for a EURopean ACcelerator neutron source.** Kley, W.; Bishop, G.R. (Directorate General for Science, Ispra, Italy). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

The Joint Research Center (JRC) has conducted studies on the feasibility of spallation neutrons to simulate the Tokamak fusion reactor first wall conditions. It can be shown that spallation neutrons, produced by 600 MeV protons impinging on a thin lead target, are simulating the fusion reactor first wall conditions as well as, or even better than neutron sources based on the D-Li stripping or D-T fusion reaction. Comparing an optimized spallation neutron source of equal beam power with a D-Li neutron source, they find a Figure of Merit: FM = (dpa.volume)/sup SNS/: (dpa.volume)/sup D-Li/ congruent to 10. Depending on the choice of a single or multipurpose research program, three different accelerator systems could be considered as the basis for EURAC, the future European neutron source.

18998 (LA—11130-C, pp 169-181) **KENS program - present and future.** Watanabe, N.; Misawa, M.; Sasaki, H. (National Lab. for High Energy Physics, Ibaraki-ken, Japan). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

KENS program, pulsed spallation neutron source program at KEK, is facing now a new situation: a next generation neutron source KENS-II is getting a broad range of support among the Japanese scientists and is expected to be realized as a part of Japanese Hadron Facility project. The present report summarizes present status of KENS facility (KEN-I') and a future prospect of the KENS-II.

18999 (LA—11130-C, pp 314-316) **Ultracold jet of polarized atomic hydrogen.** Raymond, R.S.; Court, G.R.; Crabb, D.G.; Roser, T.; Cameron, P.R. (Univ. of Michigan, Ann Arbor). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

Equipment is being built to test the applicability of low temperature atomic physics techniques to the production of dense polarized hydrogen beams. Electron-spin polarized hydrogen atoms will be stored at low temperature in a high magnetic field and then, by application of microwaves, expelled to form a beam.

19000 (LA—11130-C, pp 372-380) **Internally metallized ceramic vacuum pipe for particle beams.** Butler, B.L.; Featherby, M. (Science Applications International Corp., San Diego, CA). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

A ceramic vacuum chamber in the form of a long tube of rectangular cross section has been assembled from standard shapes of alumina ceramic using glass bonding techniques. Prior to final glass bonding, the internal walls of the tube are metallized using microelectronic industry thick and thin film and electroplating technology. These advanced processes allow for precision patterning and conductivity control of surface conducting films. The ability to lay down both longitudinal and transverse conductor patterns separated by insulating layers of glass give the accelerator designer considerable freedom in tailoring longitudinal and transverse beam pipe impedance. Assembly techniques of these beam pipes are discussed.

19001 (LA—11130-C, pp 430-440) **Artificial intelligence approach to accelerator control systems.** Schultz, D.E.; Hurd, J.W.; Brown, S.K. Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

An experiment was recently started at LAMPF to evaluate the power and limitations of using artificial intelligence techniques to solve problems in accelerator control and operation. A knowledge base was developed to describe the characteristics and the relationships of the first 30 devices in the LAMPF H+ beam line. Each device was categorized and pertinent attributes for each category defined. Specific values were assigned in the knowledge base to represent each actual device. Relationships between devices are modeled using the artificial intelligence techniques of rules, active values, and object-oriented methods. This symbolic model, built using the Knowledge Engineering Environment (KEE) system, provides a framework for analyzing faults, tutoring trainee operators, and offering suggestions to assist in beam tuning. Based on information provided by the domain expert responsible for tuning this portion of the beam line, additional rules were written to describe how he tunes, how he analyzes what is actually happening, and how he deals with failures. Initial results have shown that artificial intelligence techniques can be a useful adjunct to traditional methods of numerical simulation. Successful and efficient operation of future accelerators may depend on the proper merging of symbolic reasoning and conventional numerical control algorithms.

19002 (LA—11130-C, pp 448-465) **Future development of spallation neutron sources.** Bauer, G.S. (Kernforschungsanlage Juelich, West Germany). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

Although the lower heat dissipation per neutron produced and the easier control of a spallation target relative to a reactor core would allow higher neutron fluxes also for steady state spallation neutron sources, the likely costs of such a facility would be quite high unless superconducting linacs become available. Spallation sources with time structure, on the other hand, open up new experimental fields and - if the pulses are short as in the facilities now in operation - are in many respects complementary to steady

state sources. Even at the present design characteristics of the ISIS facility at the Rutherford Appleton Laboratory they are still far from their potential limits. On the other hand, as the average beam power increases, the option of an intensity modulated source with a reactor level time average flux plus time structure allows to exploit the neutron beams at least an order of magnitude more efficiently than on steady state sources. Powerful spallation neutron sources could share the accelerator with other facilities and thus be one facility in a multidisciplinary science park centered around a high intensity proton accelerator.

19003 (LA—11130-C, pp 466-514) **LANSCE-II.** Russell, G.J.; Legate, G.L.; Robinson, H.; Grisham, D.L.; Carlini, R. Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

A first generation pulsed spallation neutron source exists at Los Alamos, and is presently in a commissioning phase. When operating at design specifications, this source, the Los Alamos Neutron Scattering Center, will be the most intense (per burst) spallation neutron source in existence. They are investigating the possibility of incorporating a second-generation spallation neutron source into the Los Alamos Advanced Hadron Facility proposal. This next generation facility would be designed as a world class cold neutron source. They are also attempting to combine this cold neutron facility with a neutrino source for a multi-use target station. A cursory look at the feasibility of the neutron/neutrino target area is encouraging. They have sufficient latitude in possible approaches that it will take most of a year to delineate a design for an in-depth study.

19004 (LA—11130-C, pp 515-521) **Production of anti ps at EHF.** Conte, M.; Crawford, J.F.; Moehl, D.; Tschalaer, C. (Dipartmento di Fisica Dell'Universita di Genova, Italy). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

Anti Ps can be continuously extracted from the EHF Stretcher by slowly displacing the proton beam towards an internal ribbon target. Due to the size of the ribbon target, the anti p emittances can be as small as a few mm.mrad, while the momentum bite is quite large (say 5%); the momentum resolution, on the other hand, can also be small, perhaps 0.1%, depending on the detailed design of the secondary beam optics. There are in principle four methods of cooling a particle beam: (1) radiation cooling; (2) electron cooling; (3) ionization cooling, and (4) stochastic cooling. The authors discuss there in turn. Beam storage is also outlined.

19005 (LA—11130-C, pp 522-530) **Internal target secondary beams.** Abela, R.; Crawford, J.F. (SIN, Villigen, Switzerland). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

Internal (ribbon) targets for EHF have been described elsewhere. Briefly, the target would be in the form of a ribbon of some convenient material (e.g. Beryllium) perhaps 0.1 mm deep and 5 mm long, immersed in the beam of the Stretcher (or Main Ring), with the proton beam directed along the longer dimension. The target would be cooled by moving it across the beam at perhaps 30 m/sec. By steering the stored beam, secondary beam intensity can be held constant for about 90% of the time for which the Stretcher contains protons. The advantages and disadvantages of this layout are outlined.

19006 (LA—11130-C, pp 531-540) **rf Separation in a 3-6 GeV/c KAON beam.** Doornbos, J. (TRIUMF, Vancouver, British Columbia). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

Separated kaon beams in the 3-6 GeV/c momentum range are usually produced by using dc separators. However, long separators are required and the vertical angular acceptance is small. In this paper it is proposed to use as an alternative system of three rf separators. The beam within the separators is parallel in the vertical plane. In this way an order of magnitude better separation is possible than with the dc separation technique. Furthermore, the solid angle acceptance of 6 GeV/c is a factor 2.5 better.

19007 (LA—11130-C, pp 541-548) **Preliminary concept for the design of magnets at target locations.** Otter, A.; Hojvat, C. (TRIUMF, Vancouver, British Columbia). Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

A new concept of magnets with long poles is proposed for utilization in very high radiation environments, for example, at target stations. The main advantages are the possibility of locating the magnet coils at regions of low radiation field level and the elimination of vacuum joints between magnets. These two features should overcome maintenance limitations with present designs.

19008 (LBL—24000) **Multilayer-coated mirrors as power filters in synchrotron radiation beamlines.** Kortright, J.B.; Plag, P.; Perera, R.C.C.; Cowan, P.L.; Lindle, D.W.; Karlin, B. (Lawrence Berkeley Lab., CA (USA); National Bureau of Standards, Washington, DC (USA); Brookhaven National Lab., Upton, NY (USA)). Jul 1987. Contract AC03-76SF00098;AC02-76CH00016. 23p. (CONF-870610—18). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003872/JAW.

From 5. national synchrotron radiation instrumentation conference; Madison, WI, USA (21 Jun 1987).

Multilayer-coated mirrors, rather than conventional total-reflection mirrors, have been proposed as a means to reduce power incident on the first optical element of high resolution monochromators. We have designed, fabricated, installed and characterized a multilayer pre-mirror specifically for the 800 to 4000 eV range for the X24-A bending magnet beamline at the National Synchrotron Light Source. Various aspects of this application are discussed, including power and thermal considerations, beamline layout considerations and constraints, choice of multilayer materials and substrate, and techniques to ensure lateral uniformity of the multilayer. Results of a preliminary characterization of a mirror coated with a SiC/V multilayer and installed in the beamline are also discussed. 9 refs., 5 figs.

19009 (TRI-PP—87-80) **The TWOTRAN data acquisition and analysis language.** Ludgate, G.A.; Lee, L. (TRIUMF, Vancouver, British Columbia (Canada)). Oct 1987. 5p. (CONF-871006—35). NTIS (US Sales Only), PC A02. Order Number DE88900274/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

A language for specifying the data acquisition and initial event rejection requirements of experiments using the new TRIUMF VAX-based CAMAC data acquisition system has been designed and implemented at TRIUMF. Terse, low level, assembler-like syntax for the language was rejected in favor of a form more familiar to physicists, namely FORTRAN. The language is known as TWOTRAN, and is an extended subset of FORTRAN. Users write TWOTRAN programs and compile them into PDP-11 machine code using the TWOTRAN cross compiler, executing on the VAX. Compiled programs are down-loaded for execution into a CES STARBURST, installed in a HYTEC System Crate based CAMAC system. This paper describes the design of the language, from its earliest inception to its present state, and the interfacing of the language processing support system to the remainder of the data acquisition system.

19010 **Possibilities for studying short-lived nuclei produced at LAMPF.** Talbert, W.L. Jr.; Bunker, M.E. (Los Alamos National Lab., NM, USA). *Radiation Effects;* No. 1-4, 297-301(1986). (CONF-850507—).

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

Results are presented of a study of the feasibility of using a He-jet coupled on-line mass separator system at LAMPF. He-jet transport-line characteristics, and estimates for the production of

nuclei far from stability are given. Some specific areas of interest for potential studies are also presented.

4304 Storage Rings

REFER ALSO TO CITATION(S) 18865, 18992, 19767, 19768

19011 **(AD-A—186398/4/XAB) Science with synchrotron radiation and a heavy-ion storage ring.** Jones, K.W.; Johnson, B.M.; Meron, M.; Crasemann, B.; Hahn, Y. (Oregon Univ., Eugene (USA). Dept. of Physics). 1987. 19p. NTIS, PC A03/MF A01.

Pub. in Atomic and Molecular Physics, Vol. 20, No. 1, 1-18(1987).

A variety of scientific investigations of outstanding interest are now possible using an atomic physics facility (APF) based on the combination of an undulator or wiggler at: a high-brilliance synchrotron light source, a synchrotron storage ring for heavy ions, and a tandem accelerator or other source of highly ionized atoms for filling the storage ring. The APF opens dazzling new vistas for qualitatively new experiments in atomic physics and related fields since it gives improved reaction rates, provides refined energy resolution, and produces copious quantities of multiply ionized atoms in well-defined states. The APF represents a way of combining new techniques into a powerful, well-coordinated facility to deal comprehensively with the new atomic physics. The science that can be done with the APF is discussed mainly from the general view of what can be done with synchrotron radiation. The storage ring can also be used completely independently with lasers or to study ion-electric, ion-atom, or ion-ion interactions. Together, electron and heavy-ion storage rings provide an extraordinarily large number of ways of preparing and probing atoms and molecules. By employing complementary experimental methods at a single facility, the APF makes it possible to choose the very best experimental solutions to the complex measurements now necessary for frontier atomic physics experiments.

19012 **(CONF-8710242—2) APS [Advanced Photon Source] interests in PEP.** Moncton, D.E.; Shenoy, G.K.; Mills, D.M.; Viccaro, P.J.; Brown, G.; Wiedemann, H.; Winick, H.; Bienenstock, A.; Nichimura, H.; Trela, W. (Argonne National Lab., IL (USA); Stanford Univ., CA (USA). Stanford Synchrotron Radiation Lab.; Lawrence Berkeley Lab., CA (USA); Los Alamos National Lab., NM (USA)). Nov 1987. Contract W-31109-ENG-38. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005952/JAW.

From Development of PEP as a radiation source conference; Stanford, CA, USA (20 Oct 1987).

As one of the very few high-energy electron storage rings in the world, potentially available for synchrotron radiation studies, PEP represents an opportunity to accomplish certain preconstruction R and D tasks relevant to the successful construction and operation of dedicated user facilities such as the Advanced Photon Source (APS) at Argonne. Three topical areas are discussed: Accelerator R and D, Insertion Devices (ID) R and D, and Beam Line Instrumentation R and D.

19013 (LA—11130-C, pp 237-262) **Transverse collective instability in the PSR.** Neuffer, D.; Colton, E.; Swain, G.; Thiessen, H.; Blind, B.; Hardekopf, R.; Jason, A.; Lawrence, G.; Shafer, R.; Hardek, T.; Hurd, J. Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

An instability in the Proton Storage Ring (PSR) is observed as fast loss of beam during accumulation and storage when the injected beam current exceeds a threshold value. Experimental study results of the instability are presented in this paper. The instability threshold depends significantly on rf voltage, injected momentum spread, PSR sextupole strengths, and also on ring octupole strengths. The results are consistent with the hypothesis that the instability is a transverse instability excited by a transverse impedance Z/sub perpendicular to/ with absolute value of Z/sub perpendicular to/ congruent to 1 M Omega/m. The driving impedance has significant magnitude in the 30 to 300-MHz frequency range.

19014 (LA—11130-C, pp 263-278) **Impedance estimates for PSR.** Swain, G.R. Dec 1987. NTIS, PC A25/MF A01. Order Number DE88004741/JAW. (CONF-870260—).

From International workshop on hadron facility technology; Santa Fe, NM, USA (2 Feb 1987).

The proton Storage Ring (PSR), now in operation at Los Alamos, is a fast-cycling high-current accumulator designed to produce intense 800 MeV proton pulses for driving a spallation neutron source. This paper presents graphs of calculated longitudinal and transverse coupling impedances vs frequency for various components in the PSR beamline. The impedances are estimated using simplified formulas for the effects of steps, cavities, monitor plates, and other discontinuities in the beam pipe for the ring. An examination of stability limits indicates that the longitudinal impedance per harmonic should be less than something in the hundreds of ohms range and the transverse impedance should be less than something of the order of a megohm/meter at low frequencies. For the PSR, the impedances due to the harmonic buncher and due to possible high-Q resonances in the bump magnet chambers might be significant. Simplified growth rate estimates using the real part of the transverse impedance indicate that the bumper magnet coils for the fast kicker plates might be contributing to an observed instability with onset at about 10^{13} protons per bunch.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 17769, 17770, 17839, 18737, 18869, 18870, 19391, 19444, 19549, 19708, 19735, 19763, 19773, 19783, 19864, 19866, 19882, 20639, 20645

19015 (IA—1427, pp 204-206) **Microprocessor-based counting system for alpha and beta radiation.** Levinson, S.; Mazor, Y.; Matmor, A.; Wengrowicz, U. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19016 **Historical perspectives on environmental radioactivity measurements.** Sedlet, J. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **54**: 21-22(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

This paper reviews the origins of environmental radioactivity measurements, their purposes, and the development of the techniques used. It is useful to classify radioactivity as to its sources and to classify the measurements into two time groups. Four sources of radioactivity exist: (a) the primordial radionuclides, (b) cosmic radiation, (c) cosmogenic radionuclides, and (d) man-made radionuclides. Since the importance of the measurements increased greatly with the development of nuclear weapons, the measurements conveniently divide into those made before and after the first nuclear detonation in 1945. Since the future has to be predicted from the past, the following observations may be made: (1) mass spectrometry and single-atom counting will replace decay counting when the best sensitivity is needed. (2) Lower and lower levels of radioactivity will become both important and possible to measure. (3) Physical and chemical forms of environmental nuclides will be desired in addition to the amount of radioactivity. (4) The energy spectrum of environmental beta and gamma radiation will be desired in addition to the total amount of such radiation.

19017 **Recently developed instrumentation and techniques for environmental radiation measurements.** Miller, K.M. (Dept. of Energy, New York, NY). *Transactions of the American Nuclear Society;* **54**: 24-26(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

Over the years there has been increased public awareness, along with stricter government regulations regarding low-level ionizing radiation. These concerns have led to a trend where the exposures that are deemed necessary to measure have become smaller and smaller. With greater demands being placed on measurement sensitivity, the radiation protection community has had to continually develop improved instrumentation and methods of analysis. A large fraction of the radiation dose to the general population comes from sources external to the human body. In this regard, the highly penetrating gamma component of the environmental radiation field is of primary importance. Research in this field has traditionally been an integral part of the mission of the Environmental Measurements Lab. (EML). This paper highlights some of the recent developments at EML of instrument systems and measurement techniques that are useful in determining the typically small man-made increases over natural background radiation.

19018 **(BARC—1319) Calibration of cellulose-nitrate film for measurement of time-integrated concentration of radon-222 in air.** Jha, G.; Raghavayya, M. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703137/JAW.

Measurement of time-integrated concentration of ^{222}Rn in air by using solid-state nuclear track detectors (SSNTD) is finding increasing application in such diverse fields as radiation protection, exploration of radioactive minerals, prediction of earthquakes etc. While there are several types of SSNTDs sensitive to specific types of particulate radiation, films made from cellulose nitrate (CN) are found to be the best suited for quick and quantitative measurement of alpha radiation. This is because CN films are available in small thicknesses, of the order of 10-12 μm, which can be suitably evaluated by spark counting technique. This report describes the use of a sensitive thin film of CN (Kodak LR 115, Type II) for quantitative estimation of ^{222}Rn. The film (along with the base is exposed in a cylindrical plastic cup closed at one end with a special rubber membrane which permits discrimination of ^{222}Rn against ^{220}Rn, which is also present in air to varying extents. The calibration procedure, including etching and evaluation of track registration efficiency, are described in detail. The mean track registration efficiency works out to 41.9 per cent and the sensitivity of the system is found to be 58.92 tracks cm^{-2} per (Bq.litre^{-1}) day. The report lists the advantages and limitations of the system for measurement of time-integrated concentration of ^{222}Rn in air. 6 references, 5 figures, 3 tables.

19019 (IA—1427, pp 206-207) **Method for standardization of NaI(Tl) detectors and determination of absolute counting efficiencies at various geometries.** Levinson, S.; Gilad, Y.; German, U.; Shani, G.; Bergman, S. (Israel Atomic Energy Commission, Tel Aviv; Ben-Gurion Univ. of the Negev, Beersheba, Israel). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19020 (IA—1427, pp 214-215) **Radiation induced polarization in CdTe detectors.** Vartsky, D.; Goldberg, M.; Eisen, Y.; Shamai, Y.; Dukhan, R. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19021 (IA—1427, pp 215-216) **Characteristics of CaF/sub 2/:Tm (TLD-300) for radiation dosimetry.** Ben-Shachar, B.; Laichter, Y.; German, U.; Weiser, G. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19022 **(IAE—4245/14) Neutrino laboratory at Rovno NPP.** Borovoj, A.A.; Mikaehlyan, L.A.; Makeenkov, A.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701290/JAW.

Neutrino laboratory at Rovno NPP is described. Room disposition, organization of shielding against natural radioactivity back ground and experimental capabilities of this laboratory are given. The laboratory has three neutrino detectors: NaI(Tl)-scintillation spectrometer, /sup 3/He counters and a detector dummy for detecting antineutrino scattering with electron. Antineutrino flux in the point of detector disposition amounts to 10/sup 13/ cm/sup -2/ s/sup -1/. 7 refs.; 5 figs.

19023 **(INP—1235/PL) Range sensitive detector.** Sosin, Z.; Kozik, T.; Micek, S.; Grotowski, K. (Institute of Nuclear Physics, Krakow (Poland)). 1984. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701342/JAW.

A detector for identification of heavy ions at extended energy range is described. The particle energy loss is measured with ionization chamber supplied with the range-sensitive charge collection system.

19024 **(LBL—24147) The response of scintillators to heavy ions: 1, Plastics.** McMahan, M.A. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 7p. (CONF-871006—44). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005757/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

The response of various scintillator detectors to ions of A = 1-84 and energies E/A = 5 to 30 MeV have been measured, and are found to be linear above an energy of 100 MeV. Results are presented for a typical organic plastic scintillator including parametrizations of the data as a function of Z, A, and energy. These results can be used by anyone using scintillators as heavy ion detectors, with one calibration point giving a normalization that allows use of the whole set of curves. The response functions are compared to previous parametrizations at lower energies and discussed in terms of the theory of δ-ray formation in the scintillator.

19025 **(NUCLEBRAS-CDTN—589) Design construtions and testing of a self-powered neutron detector.** Correa, R.F. (Centro de Desenvolvimento da Tecnologia Nuclear, Belo Horizonte (Brazil)). 1987. 112p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number TI88701528/JAW.

The design, contruction and testing of a self-powered neutron detector (SPN) and associated electronics are described. Several tests were performed giving information about dielectrical properties od detector and cable, gamma spectra induced in the detector through reactor irradiation, detector response as a function of neutron flux, current stability and reproductibility with the neutron flux. The gamma and neutron sensitivities were also evaluated, by means of thermoluminescent dosimeters and gold foils as references. The test results are presented and show that the detector response is reliable. The gamma and neutron sensitivities are in agreement with those found in the available literature. Neverthe less, a ceramic insulated cable should be employed for permanent use in a reactor. The tests were perfomance in a 100 kW TRIGA Mark I reactor at the Centro de Desenvolvimento da Tecnologia Nuclear of NUCLEBRAS,in Belo Horizonte, Brazil.

19026 **Performance of 'Virtual Phase' CCDs as detectors of minimum-ionizing particles.** Akerlof, C.W.; Chapman, J.W.; Gialas, I.; Koska, W.A.; Nitz, D.F.; Rodricks, B.G.; Tschirhart, R.S.; Karlen, D. (Michigan Univ., Ann Arbor, USA. Randall Lab. of Physics; Stanford Linear Accelerator Center, CA, USA). *Nuclear Instruments and Methods in Physics Research;* **260**: No. 1, 80-100(1 Oct 1987). Contract AC02-76ER01112;AC03-76SF00515.

The Texas Instruments 'Virtual Phase' CCD has been the basis of an ambitious design for a precision vertex detector to be

used at the Stanford Linear Collider. The performance of this chip shows promise for future use in electron linear colliders. Experimental results are reported in addition to description of the electronic readout and preliminary mechanical design.

19027 **Method for selecting detector apertures for use in SRIXE.** Hanson, A.L. (Brookhaven National Lab., Upton, NY, USA). *Nuclear Instruments and Methods in Physics Research;* 260: No. 1, 264-275(1 Oct 1987). Contract AC02-76CH00016.

A method is presented that will help in selecting the most appropriate detector aperture size for use in SRIXE (synchrotron radiation induced X-ray emission) measurements. The criterion for selection involves maximizing the fluorescence yield while minimizing background from scattered radiation. The method uses previously published expansions of the scattering cross sections, integrated over solid angle (into 90/sup 0/), and solving for the value of the aperture aspect ratio where the crossover occurs between terms of the cross section that are proportional to solid angle and terms that change faster than the solid angle.

19028 (IA—1427, pp 201-202) **Development of 2π-proportional gas-flow counter that can be taken apart for decontamination and repair.** Levinson, S.; Assido, H.; Reich, E.; German, U. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

Published in summary form only.

In Research laboratories annual report 1986.

19029 (IA—1427, pp 208-209) **Use of G.M. detector as an environmental radiation monitor.** Matmor, A.; Elgad, D.; Gabay, Y.; Tal, N. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19030 (IA—1427, pp 210-213) **New approach to portable radiation monitoring.** Paran, J.; Tirosh, D.; Wengrowicz, U.; Gabay, Y. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19031 (UCRL—53833) **Personnel neutron dosimetry using electrochemically etched CR-39 foils.** Hankins, D.E.; Homann, S.G.; Westermark, J. (Lawrence Livermore National Lab., CA (USA)). 20 Nov 1987. Contract W-7405-ENG-48. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005099/JAW.

This report describes a personnel neutron dosimetry system based on the electrochemical etching of CR-39 plastic at elevated temperatures. The CR-39 dosimetry system has several advantages: the doses obtained using this system are more accurate than those from other dosimetry systems, especially when varied neutron spectra are encountered; CR-39 does not have the severe energy dependence that exists with albedo neutron dosimeters, nor does it have the fading and reading problems encountered with NTA film. The energy response of CR-39 to neutrons is fairly flat from about 150 keV to 4.0 MeV, but drops by about 60% in the 13 to 16 MeV range. The sensitivity of the dosimetry system is about 4.5 tracks/mrem, with a background equivalent to about 8 mrem for new CR-39 foils. The limit of sensitivity is approximately 10 mrem. We describe our three-stage electrochemical etch procedure that can be used to process large numbers of CR-39 dosimeters quickly. The stages in the etching procedure improve the track quality and the precision of the track counting, and also reduce the background counts caused by imperfections, scratches, or dirt on the foils. We are investigating the use of a track-size distribution method to determine information on the incident neutron energy or spectrum. 6 refs., 17 figs., 2 tabs.

19032 (CEA-R—5393) **Powerful modular versatile and low cost multiprocessor system for data acquisition and control of neutron spectrometers.** Koskas, G. (Laboratoire Leon Brillouin, Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Apr 1987. 24p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753175/JAW.

This paper describes the new data acquisition and control systems of the neutron scattering instruments at the ORPHEE research reactor. The existing system has undergone a complete change: the original CAMAC system and minicomputer controlling each experiment have given way to commercial CPU boards and microcomputers like the IBM PC. The communication links between these 2 components are the IEEE 488 or RS 232 standards. Emphasis is placed on flexibility and modular nature of such a system which makes a maximum use of commercial products thus guaranteeing reliability ease of use. A study of the requirements and evolutions, technical as well as philosophical, is detailed in order to demonstrate the motivation of the choice of the system architecture. A survey of the various hardware and software achievements and finally an overview on the future improvements is given.

19033 (FEI—1777) **Calculation of contribution of multiple interactions and efficiency of neutron detectors.** Androsenko, A.A.; Androsenko, P.A.; Kazakov, L.E.; Kononov, V.N.; Poletaev, E.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703164/JAW.

Results of calculation of multiple neutron interactions contribution to efficiency of detectors with ^{6}Li glass and ^{10}B plate in the energy range of 0.01-1 MeV are given. The calculation was performed by the Monte-Carlo method using BRAND program complex. It is shown that a correction value for multiple neutron interaction in ^{6}Li glass of 1 mm thickness constitutes 4.5 % at energy of up to 100 keV and at higher energies has a complex energy dependence reaching 25 % at 440 keV. 11 references, 2 figures, 2 tables.

19034 (IA—1427, pp 195-197) **Liquid scintillation and Cherenkov counting efficiencies for a number of commonly known beta and gamma emitting nuclides at low activities.** Carmon, B.; Levinson, S. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19035 (IA—1427, pp 197-198) **Radioassay of Ru-106 by Cherenkov counting in aqueous solutions.** Carmon, B. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19036 (IA—1427, pp 198-200) **Optimization in liquid scintillation assays of tritiated water samples.** Levinson, S.; Carmon, B. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19037 (IA—1427, pp 202-204) **Computerized technique for calculation of tritium activities in samples measured with a Tricarb 3385 system.** Levinson, S.; Ben-Shachar, B.; Messing, M. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19038 **(IFVE-ONF—86-9) Magnetic loss noise under detector and amplifier transformer coupling.** Krasnokutskij, R.N.; Fedyakin, N.N.; Shuvalov, R.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703235/JAW.

Submitted to the journal NIM.

The formulae to calculate spectral noise density of transformer-core losses were obtained. It is shown that noise currents induced, firstly, in the primary and secondary windings are fully correlated; secondly, the account for the finite inductance allows one to remove integral divergence of the spectral noise density previously mentioned in the literature. 15 references, 3 figures.

19039 **(JINR—R-13-87-184) Timing for subnanosecond pulses.** Heidel, K.; Ortlepp, H.-G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701390/JAW.

Timing mark shapers for signals with subnanosecond front and fall times on the basis of fast comparator microcircuits have been developed and tested. Effects of a signal shaping method, of a choice of used comparators and assembling circuit types on dependence of timing mark shift on the time walk have been investigated. It is shown that a minimum time shift can be obtained during timing mark shaping on the fall of attenuated signal. 11 refs.; 10 figs.; 2 tabs.

19040 **Compact permanent magnet proton spectrometer.** Obst, A.W.; King, N.S.P.; Hancock, A.D.; Hilko, R.A.; Klingler, Q.G.; Boyer, K.G.; Enge, H.A.; Kowalski, S.; Holsinger, R.F.; Lown, R.R. (Los Alamos National Lab., NM, USA; EG and G, Inc., Los Alamos, NM, USA; Air Force Academy, Colorado Springs, CO, USA. Dept. of Physics; Massachusetts Inst. of Tech., Cambridge, USA; Field Effects, Inc., Acton, MA, USA). *Nuclear Instruments and Methods in Physics Research;* **263**: No. 2/3, 407-413(15 Jan 1988). Contract AC08-83NV10282.

A compact spectrometer using samarium-cobalt permanent magnet material has been developed for observing 8-22 MeV protons. The spectrometer consists of a single quadrupole element followed by a dipole element. The device has an acceptance of approximately 3 msr and an instrumental resolution (fwhm) of approximately 80 keV at 10 MeV and 150 keV at 18 MeV.

19041 **(ANL-HEP-CP—87-124) Superconducting thin film vertex detector for SSC [Superconducting Super Collider] applications.** Wagner, R.G.; Gray, K.E. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 10p. (CONF-8710218—3). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005951/JAW.

From International workshop on superconductive particle detectors; Torino, Italy (26 Oct 1987).

A possibly very-radiation-hard detector based on superconducting thin film strips is described. The interaction of the thin film detector with charged particles is discussed, and the feasibility of extending previous work on alpha-particle detection to the more stringent requirements for minimum ionizing particles is considered. A novel approach to the readout is briefly outlined which utilizes the slow phase velocity of electromagnetic waves possible in superconducting waveguides. (LEW)

19042 **(CEA-N—2521) Calibration of the central electromagnetic calorimeter of UA1 proton-antiproton experiment at CERN.** Malosse, J.J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). Mar 1987. 294p. (In French). NTIS (US Sales Only), PC A13/MF A01. Order Number DE87753177/JAW.

The most important result of the UA1 experiment at CERN has been the discovery of the weak intermediate vector bosons W/sup +/, W/sup -/ and Z/sup 0/. We describe the calibration of the electromagnetic calorimeter, which gives the signature of the electronic mode of desintegration of the intermediate bosons and measures their masses. We shall discuss this process and give some experimental results.

19043 **(FEI—1839) Glow of Na(Tl) and CsI(Tl) inorganic crystals in the threshold γ radiation flux density range.** Trykov, O.A.; Filyaev, V.F.; Vasin, V.T.; Zharinov, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 13p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701429/JAW.

Results of experimental investigations into peculiarities of glow of inorganic scintillators under their irradiation with gamma-quantum pulse flux are presented. NaI(Tl) and CsI(Tl) inorganic crystals were used as samples under investigation. The flux density of gamma-quanta with 1.0-9.0 MeV energy was changed within (0.5-1.0)x10/sup 13/ cm/sup -2/ x c/sup -1/ limits. It was ascertained, that under certain gamma-quantum pulse flux densities in NaI(Tl) and CsI(Tl) inerganic scintillators, an unambiguously expressed orientation of a part of flux of photons, responsible for scintillations, in a certain area of wave legths is manifested. Oriented photon distribution is most of all manifested in a certain range of gamma-quantum flux densities: from threshold F $\sim$ 10/sup 13/ cm/sup -2/ c/sup -1/ to critical F $>$ (1-1.5)x10/sup 14/ cm/sup -2/ c/sup -1/. For example, for NaI(Tl) crystal, efficiency of primary radiation transformation into the oriented component of luminous radiation within 425+-20 nμ wave length area reaches in the flux density range indicated more than 10%. 7 refs.

19044 **(IAE—4263/2) Correlator - high-efficiency reactor antineutrino and neutron detector.** Afonin, A.I.; Belen'kij, S.N.; Dobrynin, Yu.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703200/JAW.

A high-efficiency reactor antineutrino and neutron detector constructed on the base of He-3 proportional counters is described. The system design and its physical parameters are presented. The detector is more efficient (80% for fission spectrum source located in the center of detector) than other known neutron detectors using similar recording method. The system is used as a high-efficiency reactor antineutrino integral detector in reactor neutrino experiments. 8 references, 12 figures, 2 tables.

19045 **(IFVE-OEF—85-7) System for high-voltage control for detectors with large number of photomultipliers.** Donskov, S.V.; Kachanov, V.A.; Mikhajlov, Yu.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. 12p. (In Russian). (SERP-E—140). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703210/JAW.

A simple and inexpensive on-line system for high-voltage control designed for detectors with a large number of photomultipliers was developed and manufactured. It was developed for the GAMC-type hodoscopic electromagnetic calorimeters, comprising up to 4 thousand photomultipliers. High-voltage variation is performed by a high-speed potentiometer which is rotated by a microengine. Block diagrams of computer-control electronics are presented. The high-voltage control system has been used for five years in the IHEP and CERN accelerator experiments. The operation experience has shown that it is quite simple and convenient in operation. In case of about 6 thousand controlled channels in both experiments, no potentiometer and microengine failures were observed. 3 references, 7 figures.

19046 **(IFVE-OEF—85-100) Total internal reflection coefficient of plastic oscillators and light pipes.** Peresypkin, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703211/JAW.

Submitted to the journal Instrum. Exp. Tech.

The formula describing the dependence of the disturbed total internal reflection coefficient on the angle of light arrival in plastic scintillators and light pipes is suggested. Good agreement with the experimental data obtained in other papers is shown. 8 references, 1 figure.

19047 **(IFVE-OEF—85-101) Dependence of light yield of scintillating fibers on the refractive index of a cladding material.** Gorin, A.M.; Kardanev, A.B.; Peresypkin, A.I.; Rykalin, V.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703212/JAW.

Submitted to the journal Instrum. Exp. Tech.

Formulae for estimating the cladding influence on the light yield of a scintillating fiber are presented. The results on polystyrene scintillating fibers are compared with the formulae. 5 references, 2 figures.

19048 **(IFVE-OEF—85-114) Fiber-optical light collection from scintillation calorimeters.** Kryshkin, V.I.; Ronzhin, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703213/JAW.

A method is described for collecting light from scintillation counter calorimeters by means of an optical fiber connected to a wave length shifter, covering the edge of a scintillation plate. The optical fiber passes between continuous metallic plates and guides the light to a photomultiplier. The measurements with the calorimeter prototype give the energy resolution of 8% (FWHM) for 26-GeV electrons and +- 6% uniformity across the calorimeter surface. The method proposed has a number of new advantages. 3 references, 3 figures.

19049 **(IFVE-OEF—85-175) Measuring bulk absorption length of plastic scintillators.** Peresypkin, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703214/JAW.

A simple method to measure the bulk absorption length of plastic scintillators is proposed. It allows to define surface reflection losses of scintillators as well. 5 references, 2 figures.

19050 **(IFVE-OEF—86-30) Amplitude-compensated pulse shaper with timing to mathematical gravity centre of pulses.** Vasil'chenko, V.G.; Lapshin, V.G.; Rykalin, V.I.; Dronov, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703215/JAW.

A new method of timing to the mathematical gravity center of pulses is suggested. A principal flowsheet and shaper performance implementing this method are given. The results obtained testify to advisability to using such shapers for scintillators, drift chambers, etc. Resolution of scintillation hodoscopes on the basis of HPM with such a shaper is about 1.2 ns (space accuracy is 0.6 mm for the hodoscope of 20x20 cm^2 assembled from scintillation counters of 20x0.5x0.5 cm^3). 9 references, 6 figures.

19051 **(IFVE-OEF—86-103) High-current mode in wire photodetector with a thin anode wire.** Buzulutskov, A.F.; Vasil'chenko, V.G.; Turchanovich, L.K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703217/JAW.

Charge, counting, and load characteristics of the chamber with a thin anode wire operating in the high-current (HC) mode in different photosensitive gas mixtures with triethylamine are studied. Working range in the HC mode with loading ability on the wire of 10^3 photoelectron/mmxs at gas amplification of 10^8 is obtained in the mixture CH_4^+ triethylamine. The left-right uncertainty in case of photoelectron detection is solved by means of paired anode wires. 9 references, 5 figures.

19052 **(IFVE-OEF—86-113) Study of the characteristics of a combined hodoscope calorimeter.** Binon, F.; Guanehr, M.; Dyutejl', P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703219/JAW.

The energy and coordinate resolutions as well as other characteristics of a combined detector, detecting simultaneously a large number of both photons and hadrons, were studied in the 200 GeV/c hadron beam of the CERN SPS accelerator. The detector consists of the electromagnetic calorimeter GAMS-4000 (4096 lead-glass cells) followed by the 50 t modular hadron calorimeter MHC-200 (240 sandwich-type total-absorption counters). A new method of accounting for the difference in the hadron-shower development in photon and hadron calorimeters is described. It improves considerably the energy resolution of the combined detector. The accuracy of hadron coordinate measurements is some mm. The energy resolution is typical of iron-scintillation sandwiches with wavelength shifter readout. The influence of the gap between the photon and hadron calorimeter was studied. 16 references, 10 figures.

19053 **(IFVE-OEF—86-227) New simple method for wire stretching force measurement in multiwire proportional and drift chambers.** Myalitsin, V.K.; Smirnov, E.V.; Chujko, B.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701448/JAW.

Submitted to the journal Instrum Exp. Tech. .

A new method to measure the wires stretching forces in multiwire proportional and drift chambers based on the excitation of the wire oscillations with the help of the simple electromechanical vibrator is described. Measurement results are compared with the calculational data. The new method is shown to be of high accuracy (1-2%) for measuring the stretching forces in a wide range of diameters, lengths and wire densities and their proper oscillation frequencies. 14 refs.; 4 refs.

19054 **(IFVE-OEIPK/OEA—86-36) Measuring accuracy of 3-dimensional bodies by the GOMER-1 device.** Goncharov, V.A.; Kistenev, Eh.P.; Kurnosenko, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703230/JAW.

The methods for measuring 3-dimensional bodies by the GOMER-1 device for hologram processing built for the holographic bubble chamber HOBC are described. The results of GOMER-1 holographic device data processing of ethalonic object measurements as well as accuracy performance of the device itself are presented. GOMER-1 accuracy of measurements is σ/sub x/=4.36, σ/sub y/=4.4, σ/sub z/=63.5 μm; it is not lower than the accuracy of usual measuring instruments. Use of the 3-dimensional diffraction pattern of the gauge lattice confirms the possibility of application of two-dimensional precision standards to calibrate holographic devices of the GOMER-1 type instead of precision holograms of 3-dimensional standards, which present definite difficulties. 3 references, 6 figures, 1 table.

19055 **(ITEF—71(1986)) Measurement of electron drift-velocity in Xe-CH/sub 4/ mixtures.** Artem'ev, V.A.; Zel'dovich, O.Ya.; Karelin, A.K.; Kozodaeva, O.M.; Rostovtsev, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701490/JAW.

A device for measuring electron drift velocity in Xe+CH/sub 4/ mixture, the results of measurements and their comparison with known literature data are described. Gas mixture coming to the drift chamber was analyzed by means of the LKhM-8NR gas chromatograph. Total content of impurities made up less than 0.01%. Drift velocities were measured in the following mixtures: CH/sub 4/ (100%); CH/sub 4/ (90%) + Xe (10%); CH/sub 4/

(65%) + Xe (35%); CH/sub 4/ (50%) + Xe (50%); CH/sub 4/ (80%) + Xe (20%). Composition of the mixture was controlled with an accuracy not worse than 1%. In each gas mixture drift velocities were measured in the range of drift fields from 0.2 to 0.9 kV/cm. The results of drift velocity measurements are tabulated. 6 refs.; 3 figs.

19056 **(ITEF—156(1987)) Application of static memory for data acquisition and transmission into a computer.** Borodina, I.N.; Bysheva, G.K.; Gusev, L.N.; Chernyshev, V.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701491/JAW.

A bloc diagram and principle of operation of the data acquisition and transmission system using multiwire detectos is described. There are two static memory units based on integrated circuits in the system. The volume of the static memory is 2 banc by 2048 byte. Time for filling of a data bank is 10 ms. The total time of data transmission from one bank is 5 ms. The system permits to accelerate ~ 5 times the data acquisition and transmission into a computer. 3 refs.; 5 figs.

19057 **(JINR-R—13-87-205) Two-coordinate Geiger helium chamber with special pulse-shaping electrodes.** Akimov, Yu.K.; Govorov, A.M.; Do Khoang Kyong and others. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems; Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701509/JAW.

Submitted to the journal Nucl. Instr. Methods.

Two-coordinate multiwire chamber with sensitive surface 1x1.1 m designed for experiments on search for of double beta decay is described. Results of investigation of main chamber characteristics operating in the Geiger regime are presented. It is established that the chamber efficiency on plateau constitutes 98.3% when using gaseous mixture He+CH/sub 4/+C/sub 2/H/sub 5/Br (94:5:1). To improve the measurement accuracy of a particle coordinate, additional shaping electrodes stretched perpendicular to anode wires have been introduced into the chamber. Coordinate measurement accuracy along anode wire in any place of the chamber is not lower than 2.5 mm on condition that a distance, which charge passes, is not longer than 7 cm. 2 refs.; 6 figs.

19058 **(LBL—23327) The hybridized front end electronics of the Central Drift Chamber in the Stanford Linear Collider Detector.** Lo, C.C.; Kirsten, F.A.; Nakamura, M.; Jared, R.C.; Goulding, F.S.; Yim, A.; Moss, J.; Freytag, D.; Haller, G.; Larson, R. (Lawrence Berkeley Lab., CA (USA); Stanford Linear Accelerator Center, Menlo Park, CA (USA); Illinois Univ., Urbana (USA)). Oct 1987. Contract AC03-76SF00098;AC03-76SF00515. 5p. (CONF-871006—42). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005451/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

In order to accommodate the high packaging density requirements for the front end electronics of the Central Drift Chamber (CDC) in the SLAC Linear Collider Detector (SLD), the CDC front end electronics has been hybridized. The hybrid package contains eight channels of amplifiers together with all the associated circuits for calibration, event recognition and power economy switching functions. A total of 1280 such hybrids are used in the CDC.

19059 **(LBL—23328) Test stands for the Central Drift Chamber front end hybrid in the Stanford Linear Collider Detector.** Lo, C.C.; Yim, A.K. (Lawrence Berkeley Lab., CA (USA); Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1987. Contract AC03-76SF00098;AC03-76SF00515. 6p. (CONF-871006—43). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005450/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

The Central Drift Chamber (CDC) of the SLAC Linear Collider Detector (SLD) uses 1280 front end electronic hybrid modules. Each of these modules contains over 450 components and performs numerous functions. This paper describes the four test stands for production and detailed circuit characterizations of these hybrids. Descriptions and performance of some of the important functions of the test systems will be presented here.

19060 **(LBL—24156) Readout and trigger electronics for the TPC vertex chamber.** Ronan, M.T.; Jared, R.C.; McGathen, T.K.; Eisner, A.M.; Broeder, W.J.; Godfrey, G.L. (Lawrence Berkeley Lab., CA (USA); California Univ., Stanford (USA). Intercampus Inst. for Research at Particle Accelerators; Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1987. Contract AC03-76SF00098. 6p. (CONF-871006—23). NTIS, PC A02. Order Number DE88003865/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

The introduction of the vertex chamber required the addition of new front-end electronics and a new 1024-channel, high-accuracy TDC system. The preamplifier/discriminator should be capable of triggering on the first electrons and the time digitzer should preserve the measurement resolution. For the TDC's, in order to maintain compatibility with the existing TPC readout system, an upgrade of a previous inner drift chamber digitizer system has been chosen. Tests of the accuracy and stability of the original design indicated that the new design specifications would be met. The TPC detector requires a fast pretrigger to turn on its gating grid within 500 ns of the e/sup +/e/sup -/ beam crossing time, to minimize the loss of ionization information. A pretrigger based on the Straw Chamber signals, operating at a rate of about 2 K/sec, will be used for charged particle final states. In addition, in order to reject low mass Two-Photon events at the final trigger level, an accurate transverse momentum cutoff will be made by the Straw Chamber trigger logic. In this paper, we describe the readout and trigger electronics systems which have been built to satisfy the above requirements. 5 refs., 8 figs.

19061 **(ORNL/TM—10340) A user's guide to MICAP: A Monte Carlo Ionization Chamber Analysis Package.** Johnson, J.O.; Gabriel, T.A. (Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 284p. NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE88006157/JAW.

A collection of computer codes entitled MICAP - A Monte Carlo Ionization Chamber Analysis Package has been developed to determine the response of a gas-filled cavity ionization chamber in a mixed neutron and photon radiation environment. In particular, MICAP determines the neutron, photon, and total response of the ionization chamber. The applicability of MICAP encompasses all aspects of mixed field dosimetry analysis including detector design, preexperimental planning and post-experimental analysis. The MICAP codes include: RDNDF for reading and processing ENDF/B-formatted cross section files, MICRO for manipulating microscopic cross section data sets, MACRO for creating macroscopic cross section data sets, NEUTRON for transporting neutrons, RECOMB for calculating correction data due to ionization chamber saturation effects, HEAVY for transporting recoil heavy ions and charged particles, PECSP for generating photon and electron cross section and material data sets, PHOTPREP for generating photon source input tapes, and PHOTON for transporting photons and electrons. The codes are generally tailored to provide numerous input options, but whenever possible, default values are supplied which yield adequate results. All of the MICAP codes function independently, and are operational on the ORNL IBM 3033 computer system. 14 refs., 27 figs., 49 tabs.

19062 **(RAL—87-095) Cell design and electrostatic optimisation for the ZEUS central tracking detector.** Roberts, J.H.C. (Rutherford Appleton Lab., Chilton (UK)). Nov 1987. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752357/JAW.

The report is concerned with the cell design and electrostatic optimisation for the ZEUS Central Tracking Detector (CTD). The CTD is being designed for charged track reconstruction and

particle momentum measurement in the ZEUS experiment at the HERA electron-proton collider. The contents of the report is divided into two parts. The first part describes the techniques employed in the study, and includes: design overview, voltage optimisation, strategy evolution, electrostatic screens, and optimisation over many superlayers. The second part contains a critical assessment of the results obtained, including optimised parameters, operational stability and alternative field values. (U.K.).

19063 **(SLAC-PUB—4425) A CAMAC and FASTBUS engineering test environment supported by a MicroVAX/MicroVMS system.** Logg, C.A. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1987. Contract AC03-76SF00515. 6p. (CONF-871006—25). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004625/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

A flexible, multiuser engineering test environment has been established for the engineers in SLAC's Electronic Instrumentation Engineering group. The system hardware includes a standard MicroVAX II and MicroVAX I with multiple CAMAC, FASTBUS, and GPIB instrumentation buses. The system software components include MicroVMS licenses with DECNET/SLACNET, FORTRAN, PASCAL, FORTH, and a versatile graphical display package. In addition, there are several software utilities available to facilitate FASTBUS and CAMAC prototype hardware debugging. 16 refs., 7 figs.

19064 **(UCRL—53816) Data acquisition for the LLNL fractional-charge search.** Wuest, C.R.; Hendricks, C.D. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005872/JAW.

A data acquisition system has been implemented on an experiment to detect the presence of fractional charges in bulk matter. The experiment utilizes a liquid-droplet generation technique coupled to a large electrostatic charge spectrometer. Charges are determined by measuring the deflection of each droplet after falling 5 m in the spectrometer field. Data acquisition is accomplished via a flying-spot light source and a photomultiplier tube connected to fast nuclear instrumentation (NIM) and computer automated instrumentation (CAMAC) electronics. An LSI 11/73 mini-computer is used for data taking as well as data analysis. Data can be accumulated at rates up to 20,000 droplets per second. 6 refs., 9 figs.

19065 **Test results from a precision drift chamber vertex detector prototype using dimethyl ether.** Clark, A.R.; Goozen, F.; Kerth, L.T.; Klopfenstein, C.; Loken, S.C.; Strovink, M.; Trippe, T.G. (Lawrence Berkeley Lab., CA, USA; California Univ., Berkeley, USA. Dept. of Physics). *Nuclear Instruments and Methods in Physics Research;* **261**: No. 3, 420-426(15 Nov 1987). Contract AC03-76SF00098.

Results of beam tests of a prototype drift chamber vertex detector developed for the D-Zero experiment at the Fermilab collider are reported. The chamber design emphasizes dual goals of high accuracy position measurement and excellent two track resolution. These requirements are met by using a slow gas, dimethyl ether, in a jet chamber geometry with a double plane of field-shaping wires near the anodes. Resolution of nearby hits is faciliated by 100 MHz flash digitization of the signal pulses. The prototype tested consisted of a full-lenght (97 cm) model of one azimuthal sector of the innermost layer of the detector, with 8 anode wires. Position measurement accuracy of 30-80 μm for drift distances of 2-11 mm and pulse pair resolution of 0,7 mm (for 90% of all pulses) is achieved.

19066 **Measurement of the absorption length and absolute quantum efficiency of TMAE and TEA from threshold to 120 nm.** Holroyd, R.A.; Preses, J.M.; Woody, C.L.; Johnson, R.A. (Brookhaven National Lab., Upton, NY, USA; Cincinnati Univ., OH, USA). *Nuclear Instruments and Methods in Physics Research;* **261**: No. 3, 440-444(15 Nov 1987). Contract AC02-76CH00016.

The absorption length and absolute photoionization quantum efficiency of TMAE (tetrakis-dimethylamino-ethylene) and TEA (triethylamine) vapors have been measured in a wavelength interval from 120 to 280 nm. Both of these materials can serve as a photosensitive agent for ultraviolet photon detectors used in high energy and nuclear physics experiments and for medical imaging. The absorption length and absolute quantum efficiency are important parameters in the design of these detectors. We find that the quantum efficiency for TMAE has a peak of 58% at 146 nm and rises again toward shorter wavelengths. The TEA quantum efficiency reaches a peak of 33% at 153 nm and has a plateau of 17% below 135 nm. We fail to observe a second peak in TEA around 136 nm as has been previously reported.

19067 **New method for measuring the neutron-induced background in BGO Compton-suppressed Ge detectors applied to in-beam γ-ray studies.** Holzmann, R.; Ahmad, I.; Janssens, R.V.F.; Khoo, T.L.; Radford, D.C.; Drigert, M.W.; Garg, U. (Argonne National Lab., IL, USA; Notre Dame Univ., IN, USA). *Nuclear Instruments and Methods in Physics Research;* **260**: No. 1, 153-156(1 Oct 1987). Contract W-31-109-ENG-38.

A method for measuring the response of intrinsic Ge detectors equipped with bismuth germanate (BGO) anti-Compton shields to evaporation neutrons is presented.

19068 **Signal, recombination effects and noise in amorphous silicon detectors.** Perez-Mendez, V.; Kaplan, S.N.; Ward, W.; Qureshi, S.; Street, R.A. (Lawrence Berkeley Lab., CA, USA; Xerox Palo Alto Research Center, CA, USA). *Nuclear Instruments and Methods in Physics Research;* **260**: No. 1, 195-200(1 Oct 1987). Contract AC03-76SF00098.

Some properties of hydrogenated amorphous silicon diodes are described. Back biased diodes of the Schottky, p-i-n type, in thicknesses ranging from 5-15 μm, have been tested with 6 MeV alpha particles and with 1 and 2 MeV protons. Large signal saturation, due to electron-hole recombination, occurs for high LET particles. Diodes have been exposed to fast neutron fluences up to 10/sup 13/ cm/sup -2/ and shown to have better radiation resistance than similarly exposed crystalline silicon detectors. From our measurements we extrapolate that minimum ionizing particles can be detected with stacked layers 100-120 μm thick, with adequate signal/noise levels.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 18174

19069 **(IA—1427, pp 228-229) Evaluation and testing of equipment, materials and components in space environment.** Lifshitz, Y.; Noter, Y.; Ilberg, D.; Shiloh, K.; Shamai, Y.; Israeli, M.; Haruvi, Y.; Chavet, I.; Lempert, G.; Even, O. Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19070 **Improved ^{252}Cf single-event-upset simulation technique for testing microelectronics.** Block, R.C. (Sandia National Lab., Albuquerque, NM). *Transactions of the American Nuclear Society;* **54**: 18-19(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

Considerable effort is now being expended at accelerators to test microelectronics for single event upset (SEU) from energetic heavy ions. Testing with ^{252}Cf spontaneous fission fragments is far less expensive and more readily accessible than accelerator testing, but uncertainties associated with currently used averages over the fragment distribution severely limit the validity of californium testing. This paper presents a new approach, which utilizes the properties of the californium fission process to significantly reduce the uncertainties inherent in current testing systems. By measuring SEU in coincidence with the kinetic energy and the mass, or just the kinetic energy, of the oppositely emitted fission fragment, ^{252}Cf can be used to provide an accurate determination of both the mass of the fragment and its LET as it penetrates the DUT. The kinetic energy and mass of fission fragments can readily by determined by

the E - dE/dX measurement technique. Representative systems utilizing gridded Fisch ionization chambers, surface barrier silicon diodes, or thin film plastic scintillators have been identified and evaluated as being suitable for this application.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 17464, 17567, 17619, 18118, 18180, 18228, 18404, 18747, 20357

19071 **(BARC—1362) Design and fabrication of a Czerny-Turner monochromator-cum-spectrograph.** Murty, M.V.R.K.; Shukla, R.P.; Bhattacharya, S.S.; Krishnamurthy, G. (Bhabha Atomic Research Centre, Bombay (India)). 1987. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701244/JAW.

The design and fabrication of a Czerny-Turner monochromator cum spectrograph is described. It consists of a classically ruled grating having 1200 grooves/mm. The collimator is a concave spherical mirror having a radius of curvature 1.025 metre while the focusing element is a concave spherical mirror of radius of curvature 0.925 metre. The design of two unequal radii of curvature for collimating and focusing mirrors is chosen to eliminate the chromatic aberration at the wavelength of 5000A. The linear reciprocal dispersion on the focal surface is about 8A/mm. The resolution of the instrument at the coma corrected wavelength i.e. 5000A is 0.1A. The resolution at the other wavelengths is limited by the residual chromatic aberration which increases linearly with wavelength on either side of the 5000A. Therefore the resolution at the wavelength 2000A and 8000A is about 0.2A. 7 figures.

19072 **(BNL—40626) Applications of the lateral shearing interferometer in measurement of synchrotron radiation optical elements.** Liu, Wu-ming; Takacs, P.Z.; Siddons, D.P. (Brookhaven National Lab., Upton, NY (USA)). Nov 1987. Contract AC02-76CH00016. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005184/JAW.

The use of a single plate shearing, or Murty, interferometer for measuring the surface quality of several optical elements is reviewed and several results are given. The principle of the Murty interferometer is also explained. (LEW)

19073 **(DOE/ER/60344—1) A laser-based photoacoustic spectrometer for direct breath $^{13}Co_2/^{12}CO_2$ measurement: Final report.** Walsh, F. (Tracer Technologies, Inc., Somerville, MA (USA)). Aug 1987. Contract FG02-85ER60344. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004915/JAW.

The use of ^{13}C-enriched tracers in health care settings has been limited despite repeated scientific validation and practical application advantages. One limitation has been the absence of a low-cost, operator-easy instrument for the measurement of the extent of ^{13}C-enrichment of samples obtained after ingestion or injection of ^{13}C-enriched tracers. Under DOE Contract DE-AC02-82ER60063, Tracer demonstrated that a laser-based photoacoustic spectrometer could be used to accurately measure CO_2 content in gases. The objective of the present program was to test whether such an instrument could be used to accurately measure ^{13}C-enrichment in CO_2 in breath samples. Under the present program, Tracer designed and made a dual-chamber resonant spectrophone coupled with a computer-based data acquisition and analysis system. The laser used to drive the spectrophone was a rf-modulated CO_2 laser with $^{13}CO_2$ fill. The data obtained under the program demonstrated that the laser-based photoacoustic spectrophone is capable of accurate measurement of breath samples; however, the precision in the measurement of specific samples is not sufficient to warrant the use of this instrument in health care settings. Improvements to improve the reproducibility in measurement of the instrument by improved data acquisition and averaging to minimize the effects of back-ground noise and laser energy shifts may increase the utility of this instrument. However, errors in measurement due to energy transfer between the laser-activated $^{13}CO_2$ and the 100-fold greater concentration $^{12}CO_2$ may limit the eventual precision and accuracy of this instrument to levels not sufficient to meet the requirements of health care settings.

19074 **(EGG—10282-5025) Operation manual EXCOR [for time EXtended CORrtex].** Pirkl, L. (EG and G Energy Measurements, Inc., Los Alamos, NM (USA). Los Alamos Operations). Dec 1987. Contract AC08-83NV10282. 188p. NTIS, PC A09. Order Number DE88005349/JAW.

The EXCOR recorder is a variant of the CORRTEX continuous time domain reflectometer and is designed to measure cavity collapse and chimney formation in underground nuclear tests. This operation manual includes performance characteristics, command descriptions, operating procedures, circuit descriptions, and the calibration procedure. A quick reference to EXCOR commands is also included. Appendices contain hardware schematics and software listings.

19075 **(IAE—4177/14) Nanosecond CAMAC modules.** Bessonova, N.A.; Klimov, A.I.; Meleshko, E.A.; Morozov, A.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703181/JAW.

Brief characteristics of nanosecond CAMAC units, mainly designed for precise-time spectrometry, are presented. The set of units described comprises a nanosecond pulse shaper-discriminator, a precise-timing shaper, a standard logic unit, a time-selection unit, a nanosecond coincidence circuit with programmed time resolution, a nanosecond pulse delay unit, and a linear transmission unit with an integrator. Control of the CAMAC units can be realized by means of a program (over data channel) or manually (using switches on the front panel). 7 figures.

19076 **(IAE—4204/9) Neutron diffractometers with multidetector superposition registering systems and possibilities of their application.** Naumov, I.V.; Glazkov, V.P.; Irodova, A.V.; Somenkov, V.A.; Shil'shtejn, S.Sh.; Golovin, A.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703190/JAW.

Foundations of the superposition method of neutron-diffraction image recording are presented, and characteristics of superposition systems of two generations (increase of relative aperture by a factor of 10 and 100, respectively) are given. The DISK annular diffractometer and its application to solve various structural problems is described in detail. 16 references, 16 figures.

19077 **(IAE—4237/14) Converters of time intervals of nanosecond range in the CAMAC standard.** Bessonova, N.A.; Klimov, A.I.; Meleshko, E.A.; Morozov, A.G.; Sotnikov, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703196/JAW.

Specifications and description of converters of time intervals in the nanosecond range designed for precise time spectrometry are presented. The time-amplitude converter with time resolution of 60 ps ensures operation at high loads by the stop channel (30 MHz). The counting-pulsed time-code converter has high stability of the time scale at the frequency of the reference generator equal to 500 MHz. The wide-range converter with time-time interpolator permits change of the quantization pitch of the time scale from 78 to 10 ns. 5 figures.

19078 **(IFVE-OEA—86-181) Photo-optical converter of angular displacements in digital servomechanisms.** Zhadkevich, A.L.; Karlov, G.D.; Kulikova, L.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703208/JAW.

Peculiarities of the design and electronic circuits of a photo-optical transducer converting the rotation angle of the shaft to pulse repetition are described. The unit of converter counting with quadrupling output pulses makes up 5'24", the limiting frequency is 150 kHz. Output data are transmitted stably over the current circuit at the distance up to 250 m. The converter is designed for utiliza-

tion in high-current servosystems with digital control. 3 references, 3 figures.

19079 **(ITEF—59/(1987)) Fast analog-to-digital converter.** Semenov, A.P.; Sokolova, O.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701488/JAW.

A fast analog - to - digital device for data acquisition and processing is described. Two analog-to-digital converters (ADC), an analog buffer, a clock pulse generator and an interface unit are its main elements. The fast ADC unit is constructed using large integrated circuits. The frequency of input channel digitation equals 20 MHz, ADC digit is 6 bit. The maximum duration of the signal processed is ~ 20 μs. 5 refs.; 5 figs.

19080 **(K/ETAC—6) Remote thermometry in a combustion environment using the phosphor technique.** Allison, S.W.; Cates, M.R.; Scudiere, M.B.; Bentley, H.T. III; Borella, H.; Marshall, B. (Oak Ridge Technical Enterprises, TN (USA); Sverdrup Technology, Inc., Arnold Air Force Station, TN (USA); EG and G Energy Measurements, Inc., Goleta, CA (USA)). 1987. Contract AC05-84OT21400. 11p. (CONF-870584—13). Society of Photo-Optical Instrumentation Engineers, Box 10, Bellingham, WA 98227. Order Number TI88004105/JAW.

From SPIE technical symposium on optics and optoelectronics; Orlando, FL, USA (15 May 1987).

Thermometry of hardware in high temperature combustion environments may be difficult and challenging to perform. Intrusive sensors, such as thermocouples, can significantly modify the local temperature field. Fatigue life of combustor components is a critical function of temperature. Methods based on the temperature-dependent emission properties of certain phosphors show promise in these situations. The temperature of an object, a variable area diffuser centerbody, immersed in an afterburner flame of a jet engine was measured. To our knowledge, this is the first report of a field application of the thermal phosphor technique in this type of environment. The testing, performed at Arnold Engineering Development Center, revealed that useful temperature measurements can be made. The objectives of this work were: (1) to provide a near-term solution to a thermal monitoring problem associated with jet engine testing, and (2) to investigate the phosphor technique for its potential in solving other envisioned thermal mapping problems in combustion and aerodynamic facilities.

19081 **(K/ETAC—32) Noncontact thermometry via laser pumped, thermographic phosphors: Characterization of systematic errors and industrial applications.** Gillies, G.T.; Dowell, L.J.; Lutz, W.N.; Allison, S.W.; Cates, M.R.; Noel, B.W.; Franks, L.A.; Borella, H.M. (Virginia Univ., Charlottesville (USA). Dept. of Physics; Los Alamos National Lab., NM (USA); EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations; Oak Ridge Gaseous Diffusion Plant, TN (USA)). Oct 1987. Contract AC05-84OT21400. 17p. (CONF-8711118—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005599/JAW.

From ICALEO '87: conference on electro-optic sensing and measurement; San Diego, CA, USA (8 Nov 1987).

There are a growing number of industrial measurement situations that call for a high precision, noncontact method of thermometry. Our collaboration has been successful in developing one such method based on the laser-induced fluorescence of rare-earth-doped ceramic phosphors like Y_2O_3:Eu. In this paper, we summarize the results of characterization studies aimed at identifying the sources of systematic error in a laboratory-grade version of the method. We then go on to present data from measurements made in the afterburner plume of a jet turbine and inside an operating permanent magnet motor. 12 refs., 6 figs.

19082 **(LBL—23348) Automatic testing of high resolution time digitizers.** Kolbe, W.F.; Turko, B.T. (Lawrence Berkeley Lab., CA (USA)). Apr 1987. Contract W-7405-ENG-36;AC03-76SF00098. 6p. (CONF-871006—41). NTIS, PC A02. Order Number DE88005326/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

An automated system for the testing and performance evaluation of high-resolution long-range time digitizers is described. The test system employs an IBM PC/XT or PC/AT personal computer together with appropriate hardware interfacing modules to control the digitizer under test. Precise timing intervals for testing are generated by a pulse calibration module driven by a programmable low phase noise frequency synthesizer. The time intervals measured by the digitizer are then compared under computer control with the actual intervals produced by the synthesizer for a sufficient number of cases to establish the digitizer performance. The hardware and software components used are discussed. 3 refs., 3 figs., 1 tab.

19083 **(ORNL/TM—10658) A versatile, highly-efficient, high-resolution von Hamos Bragg crystal x-ray spectrometer.** Vane, C.R.; Smith, M.S.; Raman, S. (Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 135p. NTIS, PC A07. Order Number DE88006149/JAW.

An efficient, high-resolution, vertical-focusing, Bragg crystal x-ray spectrometer has been specifically designed and constructed for use in measurements of x rays produced in collisions of energetic heavy ions. In this report the design and resulting operational characteristics of the final instrument are fully described. A wide variety of sample data is also included to illustrate the utility of this device in several areas of research. 14 refs., 38 figs.

19084 **(PNL-SA—15272) Development and evaluation of supercritical fluid chromatography-mass spectrometry: Period of performance, February 1, 1984 to February 1, 1988.** Chess, E.K.; Smith, R.D.; Kalinoski, H.T. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 9p. (CONF-871041—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005122/JAW.

From Advanced research and technology development direct utilization; Morgantown, WV, USA (13 Oct 1987).

During FY 1987, we initiated research in the evaluation of SFC/MS with polar fluids and the quantification of polar materials by SFC/MS. We have investigated the performance of the supercritical fluid chromatograph-mass spectrometer interface and have made several modifications to the probe and ion source to improve performance. We have continued to develop methodologies for fabricating capillary columns with bonded, crosslinked stationary phases that are suitable for use with polar fluids. Emphasis has also been placed on investigating the properties and range of utilities of mixed fluid systems in which a small percentage of a polar modifier has been added to a relatively nonpolar supercritical fluid. In addition, the SFC/MS methodologies developed in the past years have been applied to the characterization of fossil fuel materials. The use of polar supercritical fluids for the analysis of polar and high-molecular-weight fuel materials was actively pursued this year. Ammonia (NH_3, T/sub c/ = 133°C, P/sub c/ = 144 bar) was found to solvate materials of higher molecular weight than were soluble in either pure hydrocarbon fluids (pentane or smaller alkanes) or alcohol-modified hydrocarbon fluids (e.g., pentane-ethanol). However, the use of ammonia was limited by the high reactivity of the fluid with the polymeric materials used in ferrules for unions and as coatings on fused silica capillary columns. In an effort to avoid the reactivity of supercritical ammonia, but still maintain a polar, highly solvating fluid, methylamine (CH_3NH_2) was chosen as a substitute. The critical temperature of methylamine is only slightly higher than that of ammonia (T/sub c/ = 157°C); the critical pressure (P/sub c/ = 75 bar) is lower. 10 refs.

19085 **(SAND—87-2840) Hardware for potential unattended surveillance and monitoring applications.** Mangan, D.L. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 22p. (CONF-880159—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005494/JAW.

From 13. workshop of the Pugwash Study Group on chemical weapons; Geneva, Switzerland (23 Jan 1988).

This paper discusses equipment which may have potential application in the verification of treaties where on-site unattended surveillance and monitoring activities are appropriate. The unat-

tended nature of this equipment, although not negating the need for on-site inspection, is consistent with the approach used by the International Atomic Energy Agency (IAEA) in the verification of the Nuclear Non-Proliferation Treaty. To use unattended equipment, the features that need to be included in the design address the credibility of the information provided, i.e., the equipment contains tamper indicating features. Three different types of equipment are discussed: optical surveillance equipment, seals, and process monitors. The first two have direct application in the IAEA Safeguards approaches; the latter have been developed to provide a technology base of sensor suits for potential application in the monitoring of a Chemical Weapons Ban Treaty. 10 figs.

19086 **Interdisciplinary approach to microinstrumentation.** Haugen, G.; Hieftje, G. (Lawrence Livermore National Lab, CA). *Analytical Chemistry;* **60**: No. 1, 23A-31A(1 Jan 1988).

Scientists skilled in a range of disciplines, from engineering to chemistry and from biology to microcircuit fabrication, must collaborate to realize success in the development of microinstrumentation. Gilbert Haugen of Lawrence Livermore National Laboratory and Gary Hieftje of Indiana University discuss the scope, benefits, and objectives of microinstrumentation.

19087 **High power, millimeter and submillimeter gyrotron oscillators.** Spira, S.; Kreischer, K.E.; Wang, C.Y.; Temkin, R.J. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, MA 02139). pp 7-8 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

High power gyrotron oscillators operating between 100 and 400GHz are being developed at MIT. Potential applications include plasma heating and space-based radar systems. Present experiments include a step-tunable gyrotron capable of powers in excess of 1MW, and a submillimeter harmonic gyrotron. The MW gyrotron utilizes an 80kV, 35A beam produced by a magnetron injection gun built by Varian. This gun has a velocity ratio of 2 and a perpendicular beam spread of 4%. The gyrotron is operated with 3 μ sec pulses, but can be scaled to cw operation. Stable operation was achieved in the TE/sub 15,2,1/ at 140.8 GHz. Output powers of up to 645 GHz and peak efficiencies of 24% were obtained with single mode emission. Step-tunable single mode operation at powers >100kW was observed between 120-240GHz. In particular, 470 kW was generated at 242GHz in the TE/sub 22,4,1/ mode. Harmonic emission from this device was also observed.

19088 **State-of-the-art gamma-ray spectroscopy and its environmental applications.** Wogman, N.A.; Reeves, J.H.; Brodzinski, R.L. (Pacific Northwest Lab., Richland, WA). *Transactions of the American Nuclear Society;* **54**: 22-24(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

There are many environmental applications for gamma-ray spectrometers having backgrounds more than two orders of magnitude below standard systems. Large, high-resolution germanium ingots, which are very nearly free of radioactivity, are currently being produced. These ingots, when placed in an ultralow background system using super-clean materials, multilayered cosmic ray anticoincidence, and passive shielding, provide very low background. The spectrometers provide an improved minimum detectable activity for environmental measurements. Minimum detectable activity coupled with high counting efficiencies and good peak-to-Compton ratios have made greater sample analysis throughout possible. The minimum detectible radioactivity in the sample is becoming more important as environmental concerns and regulations require more sensitive measurement of the radioactivity levels allowed in the work place and in the home.

4404 Well Logging Instrumentation

19089 **Nuclear computational techniques at Schlumberger.** Case, C.R.; Badruzzaman, A. *Transactions of the American Nuclear Society;* **54**: 150-152(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

In oil well logging a measurement device called a sonde is lowered into a well. The sonde transmits a signal to a data acquisition system that records the signal as a function of well depth. In nuclear logging, the signals are the result of interactions experienced by neutrons and/or gamma rays as they travel from the radiation source through the formation and then back to a detector. In this paper the authors discuss the application and development of nuclear computational techniques at Schlumberger-Doll Research. These techniques are used in two different ways: (a) to predict sonde responses under conditions for which experimental measurements have not been taken, and (b) to investigate new measurement concepts. The first is important for making what are called environmental corrections. Typically a sonde will be calibrated in a series of laboratory formations to produce a basic response profile. Unfortunately, the number of environmental conditions, such as borehole size, mudcake thickness, etc., encountered in actual field operations is too large for a complete experimental calibration. Modeling is used to predict tool responses under environmental conditions for which measured points do not exist. The second use improves understanding of the physics issues involved in the transport process and guides the development of new measurement techniques. This paper concentrates on the second use.

19090 **Application of the FEMP codes to well logging problems.** McDaniel, P.J.; Lysne, P.C.; Harris, J.M. (Sandia National Lab., Albuquerque, NM). *Transactions of the American Nuclear Society;* **54**: 154-155(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

A series of finite element, multigroup, P/sub N/ (spherical harmonic) (FEMP) neutral particle transport codes has been developed at Sandia National Labs. for application to a large number of engineering problems of interest. These codes were developed to provide a consistent one-, two-, and three-dimensional methodology for both static and time-dependent transport problems. They are based on state-of-the-art solution algorithms, machine architectures, and FORTRAN standards.

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

19091 **(LA—11142-MS) A procedure for estimating the crystal densities of organic explosives.** Cromer, D.T.; Ammon, H.L.; Holden, J.R. (Los Alamos National Lab., NM (USA)). Nov 1987. Contract W-7405-ENG-36. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005112/JAW.

Existing methods of density prediction, which primarily involve the summation of appropriate atomic or group volumes of parts of a molecule, yield what we call a "normal" density for a particular chemical composition. However, the compounds of most interest as military explosives often have densities significantly above the norm and predicted densities for memebers of this group frequently are substantially underestimated. A new procedure has been developed that allows a possible crystal packing arrangement for a molecular to be determined, from which a crystal density, usually accurate to within 2% can be calculated. The technique consists of three parts: determination of a reasonable three-dimensional molecular structure; determination of several possible crystal packing arrangements (crystal structures) for this molecular structure; refinement of the unit cell parametrs, molecular orientation and position for each of the potential crystal structures. The lowest energy arrangement from step (3) is used to calculate the crystal density. The crystal densities predicted for both bicyclo-HMX and octanitrocubane are loser than those obtained from additivity methods. This result should be considered when establishing properties

for further atempts to synthesize these currently unknown compounds. 15 refs., 5 figs., 10 tabs.

19092 **(LA-UR—87-3831) High explosive systems for equation-of-state studies.** McQueen, R.G.; Marsh, S.P. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 5p. (CONF-870753—79). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003167/JAW.

From 5. topical conference of the American Physical Society on shockwaves in condensed matter; Monterey, CA, USA (20 Jul 1987).

Experimental and calculational studies were made to specify a suite of explosive impactor systems to be used in high pressure equation-of-state (EOS) measurements. 316 stainless steel (SS) was used as the driver or impactor. The investigation included some systems where the high explosive (HE) driving the plate to be used as the impactor was preshocked by another thicker SS plate. The effect of lateral confinement, either by HE or iron rings constituted part of the study. The effect of separating the HE and driver was also studied. The velocity range encompassed was from less than 4 km/s to over 9 km/s, which was observed in a two-stage experiment. 4 figs., 1 tab.

19093 **(SAND—87-2978C) Misty picture weather-watch and microbarograph project: Experiments 9412-14-18.** Reed, J.W.; Church, H.W.; Huck, T.W. (Sandia National Labs., Albuquerque, NM (USA); Army Atmospheric Sciences Lab., White Sands Missile Range, NM (USA)). 1987. Contract AC04-76DP00789. 123p. (CONF-871217—2). NTIS, PC A06. Order Number DE88003949/JAW.

From Symposium for misty picture event; Baltimore, MD, USA (7 Dec 1987).

Special meteorological observations and predictions for MISTY PICTURE are described. Ground zero measurements of winds and temperatures were used to develop predictions for needed light winds during the night for deployment of the helium bag for the precursor experiment. This also entailed correlations with the White Sands network of automated surface observation stations as well as general circulation and upper air reports from the regional synoptic weather observing and reporting network. Pilot balloon observations of upper winds and Tethersonde observations were made during bag deployment to further document local circulation developments. During the test countdown, radiosonde balloon observations of upper air temperatures and winds were made to allow prediction of atmospheric effects on airblast propagation that could break windows to nearly 200 km range from the MISTY PICTURE explosion yield. These data indicated that there would be no strong off-site propagations on shot day, but at shot time the weak convergence zone in the shot area disturbed the wind pattern and generated a northwestward sound duct. Some banded airblast focusing resulted that gave relatively high overpressures just south of the Admin Park, at the Observer's Area, and in San Antonio where a number of windows were claimed broken. Relatively weak blasts, between caustics or foci, were recorded by microbarographs at Admin Park, Stallion, and Socorro. Very weak and barely detectable waves were propagated eastward to Carrizozo where MINOR SCALE had broken windows in 1985, and to the southeast toward Tularosa and Alamogordo. Five microbarograph stations were also operated around the west side of a 200 km radius circle, to document airblast waves ducted and focused by relatively high temperatures and easterly monsoon winds near 50 km altitudes. 15 refs., 39 figs., 16 tabs.

4502 Nuclear

REFER ALSO TO CITATION(S) 18249, 18835, 18847, 19098, 19099, 19672, 20538

19094 **(AD-A—185860/4/XAB) Legality of nuclear weapons employment under the international humanitarian law of coercion control. Master's thesis.** Price, R.A. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). 1987. 125p. (AFIT/CI/NR—87-77T). NTIS, PC A06/MF A01.

This thesis analyzes the legality of nuclear weapons employment under international humanitarian law. Factual background data are given on present strategic and tactical nuclear arsenals; nuclear war strategies; targeting categories; and principal effects of nuclear weapons, including types of nuclear explosions and combined effects of multiple nuclear detonations, including the potential for environmental disaster. The legal framework is then set forth: the sources of humanitarian law (law of war); basic principles of humanitarian law (military necessity, humanity, proportionality, unnecessary suffering, and indiscriminate weapons); sanctions for violations of humanitarian norms; the impact of modern warfare; and a summary of views on the application of humanitarian norms to nuclear weapons. A tripartite analysis of the legality of nuclear weapons use is then made using express international treaty limitations, implied treaty limitations, and limitations from customary humanitarian norms. Pro and con arguments are examined in each area.

19095 **(LA-UR—87-3131) SEAT: A strategic engagement analysis tool.** Dreicer, J.; Michelsen, C.; Morgeson, D. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 6p. (CONF-880315—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000498/JAW.

From 4. IEEE conference on artificial intelligence applications; San Diego, CA, USA (14 Mar 1988).

The Strategic Engagement Analysis Tool (SEAT) is a prototype of an expert system knowledge-based discrete event simulation. SEAT realistically represents the interrelationships between the eight major subsystems in the strategic targeting and assault domain. Some of the subsystems employ run-time cognitive decision making and reasoning capabilities to represent human tactical and operational strategy decisions. SEAT's goal is to allow analysts to conduct sensitivity analysis and to determine cause-effect relationships. An intelligent interface mechanism is provided to aid the analyst in scenario creation. The interface was designed to provide on-line documentation, support for model input, logic control, and data validation prior to simulation execution. 4 refs., 3 figs.

19096 **(SAND—85-2523) Procedures for DOE-Navy exchange and approval of engineering information and material management required for production of W88-0/MK5 RBA.** Branson, N.A. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005466/JAW.

This report establishes the procedures whereby information pertaining to the W88-0/MK5, RBA, MK5 JTA, and associated test equipment configurations and nonconformances will be exchanged and approved by US Navy and DOE agencies. Material management procedures common to the Navy and the DOE will be implemented according to the provisions agreed to and reported here. Parties to this agreement are: Department of the Navy Strategic Systems Program Office; Department of Energy Albuquerque Operations Office; Navy Contractor (Lockheed Missiles and Space Co., Inc.); Mason and Hanger - Silas Mason Co., Inc., Pantex Assembly Plant; Los Alamos National Laboratory; Sandia National Laboratories.

19097 **(UCRL—96351) Making sense of the mixed alluvium in the Yucca Flat basin.** Wagoner, J.L. (Lawrence Livermore National Lab., CA (USA)). Sep 1987. Contract W-7405-ENG-48. 26p. (CONF-870961—6). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004710/JAW.

From 4. symposium on containment of underground nuclear explosions; Colorado Springs, CO, USA (21 Sep 1987).

In an attempt to unravel the stratigraphy of the mixed alluvium in the Yucca Flat basin, the author reviewed lithologic descriptions for most of the exploratory and emplacement holes in northern Yucca Flat and identified seven types of alluvial deposits. These lithostratigraphic units were defined by the percentage of detritus derived from the three main source terranes: Paleozoic clastic and carbonate rocks and Tertiary volcanic rocks; they are independent of the clast size of the sediment. Isopach and structural contour maps were constructed for each unit. Distribution of the deposits is a function of the source areas exposed during deposition of the sediments. The sources change with time as the rocks are uplifted along faults, denuded by erosion, and/or buried by subsequent younger deposits. The author calculated the average CO_2 content for each unit and constructed maps showing the spatial variation of the CO_2 content. These data help explain the geologic

evolution of the basin and aid in the planning for future emplacement sites in the Yucca Flat basin.

4503 Explosion Detection

REFER ALSO TO CITATION(S) 19679, 19680

19098 **(BARC—1337) Source-depth estimation by prediction error filtering of synthetic explosion signals.** Roy, F. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 76p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE87703144/JAW.

For detecting the depth phases, a parametric model for P signal was adopted. In other words, the primary P pulse is characterised by numerical values of a few parameters (usually 10-20). As the reflected P phase will be almost identical to the P phase, the same model will be valid for such phases also. For seismic signals, a special type of parametric model called autoregressive (AR) model is found useful. It is shown that the prediction error filter (PEF) for a given order as computer by AR model of the time series is same for the primary P phase as well as for the composite wave comprising the primary P phase and several reflected and refracted phases. Therefore, when the composite wave is convolved with its PEF, there will be large local errors around the instants when the reflected or refracted phases start entering the seismogram, thereby facilitating the identification of such phases. It is shown that using any order of the PEF, not necessarily the optimum, the depth phases can be extracted from the seismograms. However, in order to detect the depth phases unambiguously, the delay time of the depth phases w.r.t. the P phase should be ≧ 0.3s. The method could unambiguously detect the depth phases from the signals having signal-to-noise ratio ≧ 4. For weaker signals, array beams may be used to extract the depth phases. It was also demonstrated that T/sup */ (travel time to quality factor ratio)= 0.6s tends to give better results than T/sup */ = 1.0s. 40 references, 19 figures, 3 tables.

19099 **(BARC—1338) Depth of source from long period P-waves.** Roy, F. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703145/JAW.

Short-period (SP) seismograms are much better than long-period (LP) seismograms to get the time resolution needed for the focal-depth estimation. However, complex scattering effects due to crustal inhomogeneities and also the multi-pathing of signals usually complicate the short period records. On the other hand, the seismograms from long-period signals demonstrate clear coherent body waves. Therefore, for intermediate depths (15-60 km) prediction error filtering of LP signals will be useful for identifying the depth phases. Such a study was carried out in the first part of this report. In a group of 7 events, the p/sup p/ phases were extracted from LP signals and the depths so estimated compared well with the published data. For explosions at shallow depths (depth < 10 km), one expects that P and p/sup p/ phases will tend to cancel each other in LP seismograms. As the source depth increases, the cancellation becomes less effective. This feature can be used for the identification of an event as well as for getting an estimate of the source depth. This phenomenon can be successfully exploited for identifying multiple explosions, because at teleseismic distances (Δ > 30/sup o/) no LP (around 20s period) P waves will be seen in the seismogram due to such events whereas relatively strong SP signals and LP Rayleigh waves will be observed. This phenomenon was studied for 16 events. For three of these events having m/sub b/ as high as 6.1 and presumed to be underground explosions, one could not see any P wave on remaining 13 events (which were classified as earthquakes), it was possible to set a threshold value of m/sub b/ above which an earthquake should produce LP P-wave signals at a given distance. 8 references, 14 figures, 2 tables.

19100 **(BARC—1348) Characteristics of seismic sources of some Asian earthquakes and Soviet underground explosions from Gauribidanur array records.** Basu, T.K.; Arora, S.K. (Bhabha Atomic Research Centre, Bombay (India)). 1987. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701233/JAW.

Among one hundred sixty-five shallow-focus earthquakes which occurred over a six-year period (1980-1985) in thirty-five different Asian provinces, Gauribidanur array (GBA) P-wave seismograms of all of them and P/sub c/P seismograms of thirty-one of them from fourteen regions were processed to deduce temporal and spectral characteristics of their sources. These were compared with the corresponding features deduced earlier (Basu and Arora ; 1985, 1986) from eighty-eight known and presumed Soviet underground explosions. The identifiers that yielded wider separation between earthquakes and explosions included among others: (i) cube root of signal complexity per unit TMF (third moment of frequency: CTMF parameter), (ii) spectral energy ratio of P/sub c/P in two distinct frequency passbands (SENR Parameters), and (iii) normalized time-window energy ratio (NTENR parameter) and normalized spectral energy ratio (NSENR parameter) of P and P/sub c/P signals. The last two of these particularly helped to accentuate the main phase and the relative high-frequency content in the P/sub c/P record, which considerably increased the efficacy of the P/sub c/P discriminant. 5 refs., 10 figures, 6 tables.

19101 **(FOA-C—20650-9.1) Variation of the detection capability of the SKI network for presumed nuclear explosions in the USSR: 1, Integrated envelop.** Eriksson, A. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Mar 1987. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900371/JAW.

Seismic recordings of presumed nuclear explosions in the USSR at the Hagfors array and at the SKI stations are used. The signals are filtered and the optimum filter for each station and event is selected. The standard deviation is calculated for signal (S) and noise (N) levels. The S/N-ratio is calculated as the ratio between the standard deviations. S/N-ratios at SKI stations and Hagfors stations are compared. The contribution of the SKI stations to an improvement of the S/N level is investigated.

19102 **(PB—88-127782/XAB) Detection in Sweden of short-lived fission products probably vented from the underground nuclear test at Novaya Zemlya on 2 August 1987.** Bjurman, B.; Vintersved, I.; De Geer, L.E.; Arntsing, R.; Jakobsson, S. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Sep 1987. 16p. (In Swedish). (FOA-C—20673-9.2). NTIS, PC E03/MF A01.

In August 1987, the short-lived fission products, Mo-99, Ru-103, I-131, Te-132, I-133 and Ba-140, were detected in ground-level air all over Sweden. The highest concentration of I-131 was 2130 microBq/m3 at Kiruna, and such a high concentration has not been detected, except during the Chernobyl accident, for at least 15 years. By looking at activity ratios for different radionuclides, and air parcel trajectories calculated by the Swedish Meteorological and Hydrological Institute, it could be established that the most probable source of the fresh fission products detected was a nuclear explosions test on Novaya Zemlya performed by the Soviet Union on August 2, 1987. A small fraction (0.05%) of the radionuclides produced in the explosion leaked into the atmosphere, but this small fraction could easily be detected in most north European countries.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

REFER ALSO TO CITATION(S) 19672

5001 Basic Studies

REFER ALSO TO CITATION(S) 19242

19103 **(CONF-871247—1) Discussion of Charles R. Goldman's paper entitled "The importance of establishing long term environmental research".** Auerbach, S.I. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003921/JAW.

From Science, universities, and the environment symposium; Chicago, IL, USA (8 Dec 1987).

Dr. Goldman has provided some positive examples of long-term ecological research, of which his work is an outstanding ex-

ample, as well as other situations which have involved multiple individuals and, in some cases, multiple institutions. Examples of these are the US Forest Service's Coweeta Hydrological Laboratory, the site of multidisciplinary ecosystem studies involving the University of Georgia and others; the Hubbard Brook watershed program, involving Cornell, Dartmouth, and Yale universities, the US Forest Service, and, more recently, the Institute of Ecosystem Studies; the Walker Branch Watershed studies of the Oak Ridge National Laboratory, the National Oceanic and Atmospheric Administration (NOAA), and numerous university investigators. These and several other equally important studies have been successful because they were conceived and initiated by good scientists who were fortunate to be in an institutional setting where this kind of research was encouraged; or because key individuals involved had already attained sufficient stature that they were beyond some of the constraints that are often faced by university-based investigators who wish to do long-term research that has applied or mission implications. 1 fig.

19104 **(DOE/ER/60304—3) Model validation research: Comparison of simulated and observed climate patterns for the past 18,000 years: Progress report for the period February 1, 1987 to January 31, 1988.** Webb, T. III; Prell, W.L. (Brown Univ., Providence, RI (USA). Dept. of Geological Sciences). Jan 1988. Contract FG02-85ER60304. 16p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004945/JAW.

General circulation models (GCM's) for the atmosphere and oceans are being used to provide predictions for the potential climatic effects of increased concentrations of atmospheric carbon dioxide. Confidence in the GCM predictions will be much enhanced once the models are thoroughly tested in terms of their ability to simulate climates that differ significantly from today's climate. Simulating the climate of the past 18,000 years provides one opportunity to test the models. As one index of climate change, the magnitude of the global mean temperature change during the past 18,000 years was similar to that predicted for carbon dioxide doubling. The comparison of model results with paleoclimatic data can illustrate the sensitivity of the model's response to variations in the seasonal radiation budget as well as to changes in other boundary conditions. These comparisons also provide the opportunity to check the sensitivity of the climatic response of critical components of the climate system such as sea-ice. During the past several years, we have used paleoclimatic data to test the NCAR CCM, a model used in CO_2 research, after changing its boundary conditions to those appropriate for simulating past climates. We have assembled global paleoclimatic data sets of pollen, lake level, and marine plankton data, and calibrated many of the data in climatic terms. We have also developed methods that permit direct quantitative comparisons between the data and model results. Our comparisons have shown both some of the strengths and weaknesses of the model. 59 refs.

19105 **(GKSS—87/E/35) Dynamic background of a non-hydrostatic mesoscale model of the atmospheric circulation.** Kapitza, H. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude, Germany, F.R.. Inst. fuer Physik). (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Hamburg Univ. (Germany, F.R.). Fachbereich Geowissenschaften; GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). 1987. 109p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88752231/JAW.

The anelastically approximated basic equations are transformed into a rectangular computational domain. The integration is performed with the McCormack-Scheme, while the pressure is calculated by a CG-method (KAPITZA and EPPEL, 1987). Useful boundary conditions are discussed. The model is tested with stratified flow over isolated hills. Analytic solutions derived from the linearized equations are compared with results of the linear model version. Very good agreement is found as long as wave reflexions at the upper boundary are prevented. With 27 figs..

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 17459, 17619, 17634, 17635, 17645, 17662, 18455, 18458, 18463, 18465, 18917, 18918, 18923, 18924, 18925, 19334, 19557, 19559, 19560, 19639, 19640, 19650, 19651, 19653, 19654, 19655, 19656, 19657, 19658, 19662, 19667

19106 **(AD-A—185916/4/XAB) Pollution from motor vehicles and aircraft at Stapleton International Airport (abbreviated report). Revision 2.** Segal, H.M. (Federal Aviation Administration, Washington, DC (USA). Office of Environment and Energy). Sep 1987. 42p. (FAA-EE—86-11-A-REV-2). NTIS, PC A03/MF A01.

Supersedes Rept. No. FAA/EE-86-11-A/REV-1, AD-A179 286.

The air-quality impact of the proposed runway-expansion program at Stapleton International Airport is determined in this report. The method of analysis is to model the dispersion of pollutants from motor vehicles and aircraft under both 1-hour and 8-hour worst-case conditions. Results show that aircraft pollution concentrations are reduced and, in some cases, completely disappear when the new runways are added. This is caused primarily by a reduction in takeoff delays, which are major objective of the runway-expansion program at the airport.

19107 **(BNL—40457) Estimated errors incurred by using weekly air quality sampling to infer SO2 dry deposition fluxes.** Lipfert, F.W. (Brookhaven National Lab., Upton, NY (USA)). Oct 1987. Contract AC02-76CH00016. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005612/JAW.

An analysis of diurnal patterns of SO2 concentrations measured at 9 sites in the Eastern US has shown a variable pattern of bias when used to estimate weekly dry deposition fluxes. Sites with local source influences and higher concentration levels are seen to have increased tendencies for underprediction by weekly sampling. The evaluation of sites with low concentration levels may have been compromised by the lack of SO2 measurement sensitivity at low levels and should be repeated using filter pack methods. An attempt should be made to "calibrate" routine dry deposition measurement sites to account for errors introduced by weekly sampling; such calibration factors may also vary seasonally.

19108 **(CONF-870977—2) Gaseous pollutant and acidic rain impacts on crops in the United States: A comparison.** Irving, P.M. (National Acid Precipitation Assessment Program, Washington, DC (USA)). 1987. Contract W-31109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003042/JAW.

From International rain conference; Lisbon, Portugal (1 Sep 1987).

The effects of gaseous pollutants (O_3, SO_2, NO_2) and acidic rain were assessed and compared for a wide variety of crop cultivars and species. Such a comparison is useful for evaluating the need and the strategy for controlling pollutant emissions. No measurable and consistent crop yield response from the direct effects of simulated acidic rain at ambient levels has been established, although possible interactions with other stresses needs further study. For some local situations, exposures of SO_2 and combinations of SO_2 and NO_2 may reach concentrations and frequencies that could reduce crop productivity, but effects from these pollutants are not significant on a national scale. In contrast, O_3 at ambient levels during the growing season, has been demonstrated to reduce the yield by an average of 5 to 10% for the majority of crops tested.

19109 **(CONF-8603180—) Proceedings of the NAPAP [National Acid Precipitation Assessment Program] workshop on dry deposition.** Hicks, B.B.; Wesely, M.L.; Lindberg, S.E.; Bromberg, S.M. (eds.). (National Oceanic and Atmospheric Administration, Oak Ridge, TN (USA). Air Resources Labs.; Argonne National Lab., IL (USA); Oak Ridge National Lab., TN (USA); Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Systems Lab.). 1986. Contract AC05-84OR21400. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88004329/JAW.

From Workshop on dry deposition; Harpers Ferry, WV, USA (25 Mar 1986).

Knowledge of dry deposition is limited by the inability to make the necessary measurements in other than special circumstances. The need to generate confidence in the available measurement techniques was emphasized. There is need for more frequent collocation of experiments and for more collaboration of researchers. Discussions among the specialist groups focused attention on the greatly dissimilar experimental constraints associated with different techniques. A summary of relevant considerations is given. Extreme difficulties arise when trying to conduct a side-by-side comparison of all of the available methods. In all cases there is need to improve measurement methods. This developmental effort is presently underway, but augmentation is required. The present focus on questions regarding so-called acidic deposition is too confining to permit a broad-based attack on the overall problem of air pollution in the context of energy and agricultural options. A program developed in response to questions concerning acidic deposition should not be expected to address questions arising in other contexts. The acid deposition concern is real and immediate, and if carefully arranged the research program generated to provide the most urgently desired answers could also constitute an entry into a longer-term investigation of broader issues. 34 refs., 3 tabs.

19110 **(CONF-8706231—1) Mutual impacts of air pollution and energy policies.** Streets, D.G. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003060/JAW.

From Workshop on energy, the economy, and the environment: a retrospective analysis of comparative IIASA case studies; Laxenburg, Austria (23 Jun 1987).

The purpose of this workshop is to conduct a retrospective examination of a 1975 study. In 1975, the International Institute for Applied Systems Analysis (IIASA) undertook a research program designed to examine the method and the practice of energy and environmental management from a systems perspective. The purpose of the current paper is to overview one specific, but very important aspect of that study: the projection of air pollutant emissions under alternative energy scenarios. This goal is expanded into a more generally applicable discussion of the mutual impacts of air pollution and energy policies and their inextricable linkages. The State of Wisconsin is chosen to exemplify the actual trends in air pollution and energy policy that have occurred in the period 1970-1985, in comparison with the forecasted trends. Ideally, similar analyses should be performed for the other three regions, where the trends and implications may be entirely different. This paper begins with a discussion of how environmental perceptions have changed in the last decade. It then discusses the interplay between emissions of air pollutants and energy policy and practice. Specific illustrations for the State of Wisconsin follow. Finally, the paper draws conclusions regarding the disparities between projections and actual experience for the period 1970 to 1985, generalizes them as guidelines for practitioners of forecasting and policy making, and looks ahead for the remainder of the century at likely future trends and their implications for the accuracy of the forecasts made in 1975. 28 refs., 8 figs., 2 tabs.

19111 **(CONF-8710238—1) Assessing the mechanisms of crop loss from air pollutants with process models.** Luxmoore, R.J. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88003765/JAW.

From Assessment of crop loss from air pollutant; Raleigh, NC, USA (25 Oct 1987).

An approach to applying process models in site-specific and regional crop loss assessment is outlined. The method takes advantage of low-cost computation options, available plant growth models that can be adapted to pollutant impact studies, extensive data available from monitoring and experiment stations in agricultural areas, and the advances in stochastic computer methods that can account for temporal variability of weather and spatial variability of soil and plant characteristics. The approach embraces the complexities of soil-plant-atmosphere interactions as a step towards robust decisions about simplification for continuing assessment investigations. Process models can contribute to a sound knowledgeable basis for assessment programs such as the National Crop Loss Assessment Network in the United States. 74 refs.; 9 figs.

19112 **(CONF-8710247—2) Nutrient status of some contrasting high-elevation forests in the eastern and western United States.** Johnson, D.W.; Friedland, A.J.; Van Miegroet, H.; Harrison, R.B.; Miller, E.; Lindberg, S.E.; Cole, D.W.; Schaefer, D.A.; Todd, D.E. (Oak Ridge National Lab., TN (USA); Dartmouth Coll., Hanover, NH (USA); Washington Univ., Seattle (USA). Coll. of Forest Resources; Pennsylvania Univ., Philadelphia (USA). Dept. of Geology). 1987. Contract AC05-84OR21400. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004176/JAW.

From Research symposium on the effects of atmospheric pollution in spruce and fir forests in the Eastern United States and the Federal Republic of Germany; Burlington, VT, USA (19 Oct 1987).

Comparisons were made of the chemical compositions of soil, soil solution, and foliage in spruce-fir forests in the Great Smoky Mountains National Park in North Carolina, Whiteface Mountain in New York, and on the western slope of the Cascade Mountains in Washington. Soils from all sites had similar and very low base saturations (often less than 10% by the sum-of-cations method). Soil solution chemical compositions varied considerably, however, with the Smokies sites having the highest NO_3^-, SO_4^{2-}, Al^{3+}, total anion, and total cation concentrations, followed by the Whiteface and Cascade sites, respectively. The relationships between these patterns and theoretical considerations of soil-soil solution equilibria are discussed, as is the potential for Al toxicity to red spruce in the two eastern sites. 23 refs., 3 tabs.

19113 **(DOE/ER/60313—3) Sources of methane in China: A program to estimate emissions from rice paddy fields, bio-gas pits, and urban areas: Annual progress report.** Rasmussen, R.A.; Khalil, M.A.K. (Oregon Graduate Center, Beaverton (USA). Inst. of Atmospheric Sciences). 30 Nov 1987. Contract FG06-85ER60313. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004262/JAW.

We are measuring methane from rice paddy fields and bio-gas pits. The project has produced new results that we are using to sharply focus the present study. We measured ambient concentrations at Minqin, Beijing, and Chendu. We obtained flux measurements from bio-gas pits, and flux measurements from rice paddy fields. Minqin is a background site with no large local sources of methane such as rice fields or urban areas. It serves as control for the experiment. Beijing is representative of a large industrialized Chinese city not affected by rice agriculture but heavily dependent on burning coal for cooking and heating. Chendu is in the heart of the rice producing areas of China where rice paddies cover millions of acres and methane from bio-gas pits is an important source of energy. Further progress was impeded by a lack of a formal agreement between the US and PRC, which was not signed until August 1987. 9 figs.

19114 (DOE/ER/60493—1-Vol.1, pp 478-482) **Indoor nitrogen dioxide exposure: the contribution from unvented gas space heaters.** McCarthy, S.M.; Yarmac, R.F.; Yocom, J.E. (TRC Environmental Consultants, Inc., East Hartford, CT). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

This paper presents the results of a study of indoor air quality in homes which use unvented gas space heaters (UVGSH) as the primary source of space heating. Twenty-two homes, fourteen with UVGSH and eight without UVGSH, were monitored for NO_2, CO, NO/sub x/, CO_2, UVGSH operation time, temperature, relative humidity and air exchange rate. Air exchange rates were measured using the perfluorocarbon tracer (PFT) method. The results indicate that in 11 out of 14 UVGSH homes, the US EPA NAAWS for NO_2 was exceeded. In one home the CO standard was exceeded. A multiple regression model showed that indoor NO_2 concentrations in UVGSH homes were most strongly dependent upon heater use and outdoor ambient NO_2 concentrations. Ventilation rate and type of cooking heat (gas or electric) were less important in determining indoor NO_2 levels.

19115 (DOE/ER/60493—1-Vol.1, pp 483-487) **Estimation of personal exposure to residential gaseous air pollutants.** Morandi, M.T.; Stock, T.H. (Univ. of Texas, Houston). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Residential indoor concentrations of the combustion byproducts NO_2 and CO measured in ten residences located in Houston, Texas, were characterized using seven-day mean hourly concentrations, presence of combustion source, zonal differences within each house (bedroom, den, or kitchen), and nineteen different categories of hourly activities. These values are used to estimate the personal exposures to CO and NO_2 of four hypothetical residents of a home with a gas cooking stove and no smokers, whose behavior varied not only in indoor vs. outdoor routine activity patterns, but also in temporal and spatial patterns of indoor activities. It is shown that consideration of specific indoor activities and inter-zonal variability within residential environments may affect personal exposures to airborne combustion pollutants for different individuals within a households.

19116 (DOE/ER/60493—1-Vol.1, pp 488-492) **Effects of domestic wood-burning on indoor air quality - an overview.** Quraishi, T.; Todd, J. (Univ. of Tasmania, Australia). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Many of the components of wood smoke are known to be hazardous to health. Emissions from residential wood-burning appliances are increasingly being controlled by legislation. Wood-burning, particularly in open fires, can also cause significant decreases in indoor air quality. A review of several field studies indicates increased levels of respirable particulates and PAH in some homes, particularly those with open fires.

19117 (DOE/ER/60493—1-Vol.1, pp 493-498) **Nitrogen dioxide exposure assessment in greater Boston: evaluation of personal monitoring.** Ryan, P.B.; Spengler, J.D.; Treitman, R.D.; Soczek, M.L.; Yanagisawa, Y.; Wallace, L.A.; Billick, I.H. (Harvard School of Public Health, Boston, MA). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In this work, the authors report a study designed to collect data on personal exposures to nitrogen dioxide of a group representative of the greater Boston standard metropolitan statistical area (SMSA). The selection protocol was designed to ensure adequate representation of targeted, high-exposure groups and the population as a whole. An assessment of the methodology used in this study is presented with regard to its ability to represent personal exposure of the population and within the sub-groups targeted. Summary data on individual exposures will be presented. A discussion of the effect of certain personal activities, such as cooking with a gas appliance or commuting in heavy traffic will be given. Further discussion of the ability of questionnaire data to predict exposure will be presented.

19118 (DOE/ER/60493—1-Vol.1, pp 501-508) **Metals in indoor environments: sources and aspects of bioavailability and interactions.** Fishbein, L.; O'Neill, I.K. (Environ Corp., Washington, DC). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The major sources of metals in indoor environments are cigarette smoke, fuel consumption, house dust and consumer products with lead, nickel, cadmium and arsenic being of primary toxicological potential. Aspects of levels and duration of human exposure to these elements in relation to existing body burdens and subsequent, bioavailability and interactions are generally poorly known from inhalation sources.

19119 (DOE/ER/60493—1-Vol.1, pp 509-514) **Metal concentrations in indoor dust samples from German homes.** Krause, C.; Dube, P.; Neumayr, V.; Schulz, C.; Wolter, R. (Institute for Water, Soil and Air Hygiene, Berlin, Germany, F.R.). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

To characterize the general exposure to heavy metals in the general population of West Germany, indoor dust samples were collected in the form of a year-long passive collection of sedimented dust in 2744 households located all over the country. The metals and metalloids (viz., Al, As, Ba, Ca, Cd, Cr, Cu, Fe, K, Li, Mg, Mn, Na, Ni, P, Pb, Sr and Zn) in dust samples were determined by plasma emission spectroscopy and atomic absorption spectroscopy. The results are described in context of the influences from region, age and type of dwellings, industry and greenery in the neighborhood, and indoor situations and human activities. Attempts are made to examine association, if any, between indoor dust metal concentrations and people's subjectively felt grievances and metals in blood and urine samples from one person living in the sampled household.

19120 (DOE/ER/60493—1-Vol.1, pp 515-519) **Use of estimating exposure to ambient lead in calculating the air to blood lead ratio.** Clench-Aas, J.; Thomassen, Y.; Levy, F. (Norwegian Institute for Air Research, Lillestroem). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The blood to air lead ratio was calculated for children (51) and adult men (73) and women (155) exposed to low to moderate ambient lead concentrations originating from traffic pollution. The ratios were calculated as 31, 10 and 5 to 1 respectively for children, women and men. Blood lead concentrations were measured by electrothermal atomic absorption and air lead exposure was estimated for each individual by combining information from a diary with measured ambient levels.

19121 (DOE/ER/60493—1-Vol.1, pp 520-523) **Indoor measurements of mineral fibers.** Marfels, H.; Spurny, K.R. (Fraunhofer Institute for Environmental Chemistry and Ecotoxicology, Germany, F.R.). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Whereas for technical purposes asbestos and mineral fibers mainly are used in connection with other materials (cement, resins etc.), in households we often find so-called weakly bound fiber products consisting of glass and asbestos fibers but also of several types of organic and mineral fibers. These fiber products are found in heating jackets, regeneration furnaces, toasters, flat-irons, hair dryers and also in insulation plates and floor coverings as well as in air condition equipment. Preliminary measurements have been done in some private houses in the Germany, F.R., where asbestos fibers

as well as other fibrous dusts were found dispersed in the air of many rooms.

19122 (DOE/ER/60493—1-Vol.1, pp 529-533) **Water soluble salts: a comparison of indoor-outdoor concentrations and deposition velocities at three office sites.** Sinclair, J.D.; Psota-Kelty, L.A.; Weschler, C.J. (AT & T Labs., Murray Hill, NJ). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Automatic dichotomous samplers have been used to collect fine and coarse airborne particles, outdoors and indoors, at telephone offices in three US cities. Analyses of these samples provided airborne concentrations of fine and coarse mode chloride, sulfate, nitrate, sodium, ammonium, potassium, magnesium and calcium. The accumulation rates of these same ionic substances on vertical and horizontal surfaces within the offices were also determined. The respective contributions of fine and coarse particles to the accumulation rates were estimated, and deposition velocities (ratio of surface accumulation rates to airborne concentrations) were then calculated for each of the ionic species in both size modes.

19123 (DOE/ER/60493—1-Vol.1, pp 534-538) **Indoor-outdoor relationships for particulate matter and verification of exposure classifications.** Quackenboss, J.J.; Lebowitz, M.D.; Crutchfield, C.D. (Univ. of Arizona, Tucson). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

As part of a study on the effects of air pollutants on respiratory health, measurements of indoor inhalable (PM_{10}) and respirable (PM/sub 2.5/) particulate matter have been collected in a sample of exposure-classified households. Based on a baseline environmental questionnaire, homes were classified as likely to have low (≦ 25 $\mu g/m^3$; 47.4% of homes), intermediate (> 25 through 40 $\mu g/m^3$; 18.3) or high (> 40 $\mu g/m^3$; 34.3%) respirable PM levels due to major indoor sources (tobacco smoke, wood burning). Outdoor particle sampling near these homes was conducted by the Pima County Air Quality Control District. This paper will discuss the indoor-outdoor relationships for particulate matter of these size ranges for homes with and without major indoor sources of suspended particulate matter.

19124 (DOE/ER/60493—1-Vol.1, pp 541-544) **Type of floor airborne and settling particulates in a day-care institution.** Aalykke, C.; Kahr, O.; Lundqvist, G.R. (Aarhus Univ., Denmark). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The interior surface and materials of a room are important factors for to the concentration of microorganisms and suspended particulate matter (SPM) in the indoor environment. It has been suggested to avoid carpets in rooms in day-care institutions and schools, and instead prefer a floor material with a hard surface. A controlled study was performed, in which carpets were removed in some rooms and replaced with a cork-linoleum floor. The authors found that while the rooms had the same occupancy, activity level and ventilation rates, a lower amount of airborne bacteria but no change of SPM were found in the room with a hard floor. However, day to day differences, between the mean values could be larger than the differences between the rooms with a soft textile floor or a hard linoleum floor on the same day.

19125 (DOE/ER/60493—1-Vol.1, pp 545-548) **CO, particulates, lead levels in the indoor environment in Riyadh, Saudi Arabia.** Al-Mutaz, I.S. (King Saud Univ., Saudi Arabia). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

This paper reviews the results of some previous works done in residential areas in Riyadh, Saudi Arabia. Both indoor and outdoor concentrations were recorded. The ratio of the indoor concentration to the outdoor concentration of carbon monoxide, CO, varied between 0.36 to 0.78. Indoor outdoor concentration ratio of the total suspended particulates, TSP, and inhalable particles, IP, were between 0.1 to 0.70. Lead concentration in the atmosphere depends heavily on the traffic density. This paper also analyzes those results and explores the possible reasons behind the high indoor outdoor concentration ratio.

19126 (DOE/ER/60493—1-Vol.1, pp 549-553) **Chamber and field studies of respirable suspended particulate deposition rates indoors.** Bluyssen, P.; Van De Loo, H.; Leaderer, B.P. (Eindhoven Univ. of Technology, Netherlands). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The deposition rate for respirable suspended matter (RSP), the particle phase of environmental tobacco smoke, was evaluated in a series of chamber studies. The model developed was then assessed in a small field of five office spaces. In the chamber studies RSP deposition velocity varied considerably as a function of air turbulence and to a lesser extent surface area and type of material and relative humidity. The greater the air turbulence, surface roughness and surface area of material and humidity, the greater the deposition velocity of RSP. The deposition rates measured in the field study agreed reasonable well with those predicted from the chamber results. The results indicate that a RSP deposition rate for the particle phase of environmental tobacco smoke of from 0.2 equivalent air changes per hour (ach) t 0.6 ach may be typical for indoor spaces with high recirculation rates.

19127 (DOE/ER/60493—1-Vol.1, pp 554-558) **Monitoring respirable suspended particles in the indoor environment.** DiNardi, S.R. (Univ. of Massachusetts, Amherst). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The use of a mobile instrument package in monitoring the concentration of respirable suspended particles (RSP) in the indoor environment is described. Both light-scattering and piezobalance methods are used to determine particle mass concentrations; while a laser aerosol spectrometer is used to determine particle size distributions in the 0.09 to 3.05 micrometer (um) range. In addition, carbon dioxide and carbon monoxide concentration, air velocity, temperature, barometric pressure and relative humidity are also monitored. A personal computer reads each instrument at five-second intervals and computes the five minute averages, in a spreadsheet format, for subsequent analysis.

19128 (DOE/ER/60493—1-Vol.1, pp 559-563) **Measurements of submicron particles by CNC and diffusion battery.** Fujii, S.; Tarumi, H.; Kim, K.Y.; Hayakawa, I. (Tokyo Institute of Technology, Japan). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

This paper presents continuous measurements of submicron particles in urban air by using three type counters. The peak size and the changes of size distribution are discussed. The results show that coagulation is one of the effective kinematic phenomena for the change of size distribution. Furthermore, measurements of submicron particles generated by combustion are conducted in an experimental chamber and the results are described in terms of coagulation. The changing characteristics of size distribution are similar to that of submicron particles in atmosphere.

19129 (DOE/ER/60493—1-Vol.1, pp 564-568) **Indoor air aerosols: outdoor air influence on indoor air.** Kulmala, M.; Saari, H.; Raunemaa, T.; Olin, M. (Univ. of Helsinki, Finland). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Elemental concentrations of particles in indoor air has been determined. These concentrations are affected by ventilation and filtration and by several indoor processes. Theoretical simulations and measurements cleared up the effects of ventilation, filtration, deposition on surfaces and resuspension. Connection to outdoor concentration was examined in detail.

19130 (DOE/ER/60493—1-Vol.1, pp 569-574) **Elemental composition of indoor fine particles.** Lebret, E.; McCarthy, J.; Spengler, J.; Chang, B.H. (Harvard School of Public Health, Boston, MA). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Aerosol sampling in 20 homes and one outdoor central site was conducted at Watertown, MA during the winter of 1985-1986. Aerosol elemental composition was determined using x-ray fluorescence. Also, fine particle mass was measured gravimetrically. To demonstrate the importance of indoor aerosol sources, elemental enrichment factors (EF) were estimated relative to outdoor aerosol composition using Pb as reference element. Elements with EF 1/2 2 had significant indoor sources, whereas elements with +EF 1/4 2 were mostly attributed to outdoor sources. Correlations between elements revealed some grouping. Fine mass was found to be correlated only with elements originating indoors such as Cd, and to a lesser extent K. Since tobacco consumption appears to be the driving force for elevated fine mass concentrations, these results suggest tobacco as the source of Cd.

19131 (DOE/ER/60493—1-Vol.1, pp 575-579) **Multivariate analyses of indoor and outdoor aerosols: a comparison of cluster and factor analytic results.** McCarthy, S.M. (TRC Environmental Consultants, East Hartford, CT). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

This paper compares the results of two different types of multivariate analyses of indoor and outdoor aerosols, cluster and factor analysis. The data were collected over a period of one year from five residences in the rural community of Portage, Wisconsin in the north central portion of the USA. The goal of the research is to determine the fraction of the indoor aerosol which is of outdoor origin and then to identify indoor aerosol sources. Two main findings from this work are: (1) the older homes had substantial variance explained by the regression and (2) the indoor source attributions made on the basis of the cluster analysis is supported, and thus strengthened by the principal component-regression analyses.

19132 (DOE/ER/60493—1-Vol.1, pp 580-583) **Man-made-mineral fibers in the indoor climate caused by ceilings of man-made-mineral wool.** Nielsen, O. (Danish Building Research Institute, Hoersholm, Denmark). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In order to study the fallout of man-made mineral fibers (MMMW) from acoustic ceilings the Danish Building Research Institute (SBI) in collaboration with the National Institute of Occupational Health has studied the particle contents of room air in approximately 140 rooms with acoustic ceilings grouped in 8 categories. The findings of this research study were published in catalogue form. This paper deals with the background for the study, the employed methodology and the principal findings of the study.

19133 (DOE/ER/60493—1-Vol.1, pp 584-589) **Study of pollution by airborne particulate matter in subway stations.** Ozao, S.; Nirei, T.; Yamagishi, N.; Yoshizawa, S.; Irie, T.; Sugawara, F. (Nippon Institute of Technology, Saitama-ken, Japan). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Field studies were carried out on air pollutants in five subway stations. The timely variation of concentrations of particulate matters, CO, CO_2, etc., size distributions of particulates and other parameters, also the contribution rates of metal Fe aerosol dispersed from wheel and rail to mass concentrations using atomic mass spectrometer were examined. Particulate shedding from the movements of trains and wind caused by them were also calculated. The air environment conditions inside coaches in operation and relations among air pollutions of three adjoining subway stations were obtained. Size distribution patterns of particulates in five subway platforms were found similar and metal Fe rates were found proportional to the depth from the ground level.

19134 (DOE/ER/60493—1-Vol.1, pp 590-594) **MMMF ceilings in kindergartens - health effect.** Rindel, A.; Hugod, C.; Bach, E.; Breum, N.O. (National Board of Health, Copenhagen, Denmark). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In 24 kindergartens the relation between the presence of readily visible man-made mineral fiber (MMMF) products in the ceilings and the presence/frequency of symptoms and diseases, and the correlation between the presence/frequency of symptoms and diseases and the concentration of man-made mineral fibers in the indoor environment was investigated. A combination of traditional epidemiological technique and a technical analysis of a number of indoor air parameters did not support the hypothesis that release of MMMF from readily visible man-made mineral fiber product in the ceilings should be mainly responsible for the occurrence of symptoms/diseases related to in-door exposure in kindergartens.

19135 (DOE/ER/60493—1-Vol.1, pp 595-599) **Easy method for measuring the quality of cleaning.** Schneider, T.; Eriksen, P.; Vinzents, P.; Petersen, O.H.; Hansen, B.K. (Danish National Institute of Occupational Health, Hellerup, Denmark). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Large sums are spent on cleaning offices, schools etc. Surprisingly, no objective field method for assessment of the efficiency of cleaning routines is in use. A sticky foil method has been developed for sampling and assessing the amount of dust present on a non-textile surface by measuring the percentage of light diffusely transmitted through the foil. The results were calibrated against % area covered as determined by microscopy. The method is reproducible easy to use, quick and can detect less than 0.2% coverage. A sampling strategy was formulated and used to demonstrate the effect of a weekly cleaning routine. Having such a method makes it possible to establish a baseline in terms of measured values against which any surface or cleaning program can be compared.

19136 (DOE/ER/60493—1-Vol.1, pp 600-605) **Quantitative microscopic analysis of indoor particle deposition samples.** Schultz, E. (Zentrale Medizin-Meteorologische Forschungsstelle, Freiburg, Germany, F.R.). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In a three month study dust collection plates were applied to indoor particle deposition measurements. The collected matter was analyzed by optical microscopy. Image analysis provides a rapid and reproducible measurement of single particle properties. Indoor

samples were taken in three homes and at one point outside. Indoor/outdoor ratios for total mass deposition rates and fly ash number deposition rates were found to be near 0.5, while indoor/outdoor ratios of minerals and biogenic particles have a value of about one, due to stronger indoor sources. Mean particle diameter has a higher value outdoors. Family activities lead to high variations in deposition rates. Outdoor influences were found to be rather weak.

19137 (DOE/ER/60493—1-Vol.1, pp 606-609) **Indoor concentrations of total suspended particulate matter, respirable particles and smoke in kindergartens and primary schools.** Sega, K.; Kalinic, N.; Sisovic, A. (Institute for Medical Research and Occupational Health, Zagreb, Yugoslavia). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Indoor concentrations of total suspended particulate matter (TSP), respirable particles (RSP) and smoke were measured in ten kindergartens and ten primary schools located in different parts of the town. The measurements were performed twice, for two weeks in summer and again in the winter period. Average concentrations and ranges for RSP, TSP and smoke content in RSP and TSP were determined for each sampling site. The differences between winter and summer results were calculated and discussed.

19138 (DOE/ER/60493—1-Vol.1, pp 610-614) **Commercial building ventilation rates and particle concentrations.** Turk, B.H.; Grimsrud, D.T.; Brown, J.T.; Geisling-Sobotka, K.L.; Harrison, J.; Prill, R.J. (Lawrence Berkeley Lab., CA). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1). Contract AC03-76SF00098.

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Ventilation rates have been measured in 38 commercial buildings that represent a variety of use types, sizes, ages, and mechanical system configurations. A single tracer (SF_6) test was conducted once at 36 buildings over a two to four hour period based on mechanical system operation for a prior two-week period. Two buildings were tested a second time under different environmental conditions. Whole building ventilation rates ranged from 0.3 ach to 4.2 ach for the 40 building measurements with an average value of 1.5 ach. Several pollutants were also monitored in the buildings for 10-day periods during working hours. Respirable suspended particles was the pollutant group that most frequently approached or exceeded elevated levels and was usually associated with local tobacco smoking.

19139 (DOE/ER/60493—1-Vol.1, pp 617-621) **Microflora of the typical home.** Tyndall, R.L.; Dudney, C.S.; Hawthorne, A.R.; Jernigan, R.; Ironside, K.; Metler, P. (Oak Ridge National Lab., TN). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1). Contract AC05-84OR21400.

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Airborne microorganisms in several hundred typical homes in eastern Tennessee were studied. The predominating bacterial genera in home and outside air were Bacillus, Micrococcus, and Staphylococcus. The predominating fungal genera in both indoor and outdoor air were Aspergillus and Penicillium. Airborne fungi levels increased both indoors and outdoors in the summer. The microbial content of exhaust air from refrigerators and air-conditioning systems was qualitatively similar but of lower concentration than room air. The direct fluorescent antibody test was used for presumptive evidence of Legionella in hot water systems. Legionella-positive water samples were observed in approximately 20% of homes and did not correlate with water temperatures but appeared more prevalent in well water.

19140 (DOE/ER/60493—1-Vol.1, pp 622-626) **Assessment of non-pathogenic bioaerosols in indoor environments.** Morey, P.; Burge, H.; Chatigny, M.; Feeley, J.; Kreiss, K.; Otten, J.; Peterson, K. 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The American Conference of Governmental Industrial Hygienists' (ACGIH) Committee on Bioaerosols is developing a generic protocol for the collection and analysis of non-pathogenic bioaerosols in indoor environments. Listed are some of the salient points of this protocol which will be published in Applied Industrial Hygiene in 1987.

19141 (DOE/ER/60493—1-Vol.1, pp 627-631) **Microbiological contamination for air conditioning systems in Japanese buildings.** Yoshizawa, S.; Irie, T.; Sugawara, F.; Ozawo, S.; Kohsaka, Y.; Matsumae, A. (Institute of Public Health, Tokyo, Japan). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Fungal and bacterial particle contamination in air conditioning systems and supply air were investigated in four buildings in Tokyo area. At the steady state operation the concentration was very low but the turbulence such as starting the system, opening the service door or changing filters during operation of system caused significant increase. Fungi and bacteria were of human and earth origin.

19142 (DOE/ER/60493—1-Vol.1, pp 632-636) **Airborne fungal spore and bacteria levels in Finnish homes with different ventilation systems.** Reponen, T.; Nevalainen, A.; Raunemaa, T. (Univ. of Kuopio, Finland). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The fungal spore, bacteria and total particle mass levels were monitored inside and outside apartment buildings with different ventilation systems. First sampling was carried out on completion of the houses before the tenants moved in and later during different seasons. The sampling was performed with a six-stage impactor for spores and bacteria and Nuclepore filters for total particle mass. The results show that mechanical supply and exhaust ventilation decreases indoor levels of fungal spores. The effect is not so evident for bacteria or total particle mass. The effect of occupancy could, however, be seen on indoor bacteria and total particle mass levels.

19143 (DOE/ER/60493—1-Vol.1, pp 637-642) **Indoor mold exposure and health effects.** Holmberg, K. (National Bacteriological Lab., Stockholm, Sweden). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Subjective complaints reported by 33 adult occupants in 13 buildings with interior mold sources, were recorded by a standardized questionnaire, and an interviewer-administered questionnaire completed by a physician. The questionnaire data from these 2 sources was compared, and examined for reporting bias. The patterns of responses were similar, and indicated an overall prevalence rates of 73% for subjective complaints of eye and skin irritation, respiratory symptoms and constitutional symptoms such as headache and fatigue. Microbial analyses identified the interior mold sources as overgrowth of Aspergillus fumigatus and A. flavus. Total airborne fungal levels averaged 343 +/- 406 colony forming units (cfu) per m^3, and airborne Aspergillus counts 116 +/- 132. Other environmental measurements included indoor relative humidity, ventilation rate, and tests for other air contaminants in the occupied spaces.

19144 (DOE/ER/60493—1-Vol.1, pp 643-647) **Effect of humidification on indoor air fungal spores counts in apartment buildings.** Jantunen, M.J.; Nevalainen, A.; Rytkoenen, A.L.; Pellikka, M.; Kalliokoski, P. (National Public Health Institute, Kuopio, Finland). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

To study the effects of Wintertime indoor air humidification on the fungal spores levels a series of field experiments in inhabited apartments was carried out. Increasing the relative humidity levels from 18...40% to 38...62% by steam evaporators reduced the levels of fungal spores significantly in inverse proportion to the humidity level. Release of spores from Penicillium and Aspergillus cultures as a function of humidity as studied further in the laboratory. The result was a sharp reduction in spores release, when relative humidity was increased from 40% for Aspergillus, and from 55 for Penicillium, in agreement with the field results.

19145 (DOE/ER/60493—1-Vol.1, pp 648-652) **AMOEBAE: the cause of humidifier fever.** Finnegan, M.J.; Pickering, A.C.; Davies, P.S.; Austwick, P.K.C.; Warhurst, D.C. (Wythenshawe Hospital, Manchester, England). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Sera from 115 workers exposed to four different contaminated humidifiers were examined by the immunofluorescent antibody (IFA) technique for antibodies to amoeba Acanthamoeba (A.) polyphaga and Naegleria (N.) gruberi. Of the sera, 25 were from workers with humidifier fever (HF). A positive IFA test correlated with strength of precipitation reaction to humidifier antigen, but not with smoking habit, work related symptoms (detected by standard questionnaire) or with HF. Amoebae were identified in all humidifiers studied.

19146 (DOE/ER/60493—1-Vol.1, pp 655-659) **Effects of aircoolers on city dwellers.** Al-Zubaidy, T.S. (Institute of Medical Technology, Baghdad, Iraq). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The role of aircoolers on health of city dwellers was investigated. The water sump was found to support the growth of different bacteria of medical importance. The drawn air was loaded with various types of bacteria; some of which implicated in human diseases. The plates settling technique set at twenty places in institute indoors, showed the presence of different pathogenic bacteria. The fifty students who were exposed to aircoolers were interviewed, and two of them complained from nose and throat irritation (4%) and two more from lassitude (4%). But the sera of all of them failed to show positive reaction against sump concentrate antigen, except five of them (10%) who showed weakly positive reaction only.

19147 (DOE/ER/60493—1-Vol.1, pp 660-664) **Airborne microbial flora in Florida homes (preliminary study).** Binnie, P.W.H. (ACVA Atlantic Inc., Fairfax, VA). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A preliminary study in eleven Florida homes showed levels of airborne bacteria and fungi to be close to or greater than a commonly used standard of 700 colony forming units per cubic meter of air (cfu's/cu m) as sampled by four different methods. Two of the methods, the Andersen Two-Stage Sampler and the Reuter Centrifugal Sampler, showed compatible results and consistently trapped a wide range of fungi. The other two methods, an air sampling pump using cellulose filters and the settlement plate method, gave much lower counts and a narrower isolation range of fungi. The range of fungi isolated included several groups known to cause allergic reactions in humans and it is planned to carry out a larger study involving up to 100 homes in different climate zones in the country using the Andersen Two-Stage Sampler and the Reuter Centrifugal Sampler.

19148 (DOE/ER/60493—1-Vol.1, pp 665-667) **Airborne fungal allergens pass through an air conditioning system? preliminary results.** Elixmann, J.H.; Linskens, H.F.; Schata, M.; Jorde, W. (Katholieke Universiteit, Nijmegen, Netherlands). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Fungal spores, an important fraction of the aeroplancton particles, can be retained by filters of an air-conditioning system, resulting in a drastic reduction of spores in the conditioned rooms. Nevertheless, when using the ELISA inhibition test against Aspergillus fumigatus it was found that air samples from conditioned rooms show inhibition of the activity of a serum from a highly sensitized patient. There is evidence that airborne allergens being detached from their allergen-carriers can pass through either coarse or fine filters of an air-conditioning installation.

19149 (DOE/ER/60493—1-Vol.1, pp 668-672) **Microbiological studies on carpets versus hard floors in non-industrial occupations.** Gravesen, S. (Allergologisk Laboratorium/ALK, Copenhagen, Denmark). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The aim of our investigations was to obtain basic knowledge of the amount and type of dust in carpets and on bare floors in order to elucidate one of the factors affecting persons with airway symptoms such as specific allergy, nasal hyperreactivity or persons with less well-defined but manifest symptoms.

19150 (DOE/ER/60493—1-Vol.1, pp 673-677) **Quantitative evaluation of indoor microbial contamination on airborne, surface and bulk material samples.** Jurinski, N.B. (NuChemCo, Inc., Alexandria, VA). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

This paper reports activity to relate concentrations of organisms found present in sampled air of a contaminated building with measurements taken from surfaces and bulk materials suspected to be similarly contaminated. The findings from the survey indicate that the numerical upper limit designations for concentrations of airborne organisms (CFU/M^3) previously suggested by health advisory organizations and committees for separating a non-problem building from one with an active problem may have been overestimated. The study also provides insight into the differences in findings based upon the type of measurement employed - air, surface or bulk sample measurements.

19151 (DOE/ER/60493—1-Vol.1, pp 678-680) **Airborne bacteria, fungal spores and ventilation in Finnish day-care centers.** Nevalainen, A.; Jantunen, M.; Pellikka, M.; Pitkaenen, E.; Kalliokoski, P. (National Public Health Institute, Kuopio, Finland). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

An indoor air quality survey was carried out in 11 day-care centers provided with a natural ventilation or mechanical exhaust and/or supply ventilation. Airborne bacteria and fungal spores were sampled during the daytime activities. Indoor air T and RH were registered and the ventilation efficiency was measured using freon as tracer gas and IR detection. The long mean (logSD) and range of the bacterial counts were 1690 (2, 37) and 180-8500 cfu/m^3 and of the fungal spore counts 70 (2, 86) and 10-340 cfu/m^3. The impact of children's activities could be seen in all-day monitoring.

The bacterial counts were generally higher than those measured in homes or offices. Enhanced ventilation lowered the airborne bacteria levels.

19152 (DOE/ER/60493—1-Vol.1, pp 681-684) **Fungal load of indoor air in historical and newly constructed buildings used by public services.** Ohgke, H.; Geers, A.; Beckert, J. (Medical Univ. Luebeck, West Germany). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Fungal colony-forming units were determined volumetrically in 58 rooms of 5 historical buildings (more than 100 years old) and in 72 rooms of 6 newly constructed houses. In the rooms of both groups of buildings without microbially colonized wet sites the medians of fungal air counts ranged between 16 and 53 cfu/m³, though the old buildings showed higher counts as a tendency. Median fungal counts of indoor air in rooms with apparent fungal colonization ranged from 156 to 340 cfu/m³. Fungal air counts exceeding 100 cfu/m³ should be followed by thorough inspection of the building and removal of the most probable fungal reservoir.

19153 (DOE/ER/60493—1-Vol.1, pp 685-689) **Indoor aerobiological pollution in creation-Indian domestic environments.** Raza, S.H.; Kauser, R. (Osmania Univ., Hyderabad, India). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The paper deals with the bacterial and fungal populations and other pollutants in the indoors of slums, middle class and upper class dwellings. Both allergenic and non allergenic organisms have been observed to be higher in slums than in other dwellings. Further the females were more susceptible to various kinds of allergies than males.

19154 (DOE/ER/60493—1-Vol.1, pp 690-693) **Legionellae in aerosols and splashwaters in different habitats.** Seidel, K.; Baez, G.; Boernert, W.; Seeber, E. (Institute for Water, Soil and Air Hygiene, Berlin, Germany, F.R.). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Legionellae are widespread in different freshwater both natural and technical environments. Since Legionellae, from water transmitted via air may cause different types of human sickness up to human death the authors investigated the transfer of Legionellae from different types of water into the surrounding area (aerosol and aerosol + splashwater samples) where contacts with humans are likely. Only a few Legionella-positive samples were found in real outdoor environments, mainly inside large scale cooling towers with closed cooling cycle, while 32 out of our 268 aerosol and 68 from 456 aerosol + splashwater indoor samples showed the dominating species Legionella pneumophila in the air. L. longbeaches was the only other detected species in 1 aerosol sample near the activated sludge type sewage treatment plant.

19155 (DOE/ER/60493—1-Vol.1, pp 694-698) **Indoor air mycology - aspergillosis, mucormycosis and cryptococcosis caused by fungal spores from indoor air.** Staib, F.; Seibold, M.; Heissenhuber, M. (Robert Koch Institute, Berlin, Germany, F.R.). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In Berlin (West), various species of the genus Aspergillus and of the family Mucoraceae and also Cryptococcus neoformans were found to be the most common causative agents of airborne invasive fungal infections in the immunocompromised host. The soil of potted plants and bird manure proved to be the main sources of infections in hospitals and homes.

19156 (DOE/ER/60493—1-Vol.1, pp 699-706) **Control of airborne fungal spores in a university hospital.** Streifel, A.J.; Rhame, F.S.; Vesley, D.; Murray, B. (Univ. of Minnesota, Minneapolis). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The University of Minnesota has been a major Transplantation Center for 20 years. Infections caused by common airborne fungi in the immune suppressed transplant patient are extremely difficult to eradicate. Air quality control was found to be essential for preventing infections caused by the breathing of airborne mold of the genus Aspergillus. A new University Hospital was constructed with a whole building air quality control concept. Included in the design were a sealed building, high efficiency filtration, controlled airflow and isolation of highly susceptible patients. Air quality monitoring of particles and airborne fungi demonstrate effective control of respective air quality parameters.

19157 (DOE/ER/60493—1-Vol.1, pp 707-712) **Study of the collection characteristics of Andersen biological air samplers - estimation of size distribution of real aerosols.** Sugawara, F.; Yoshizawa, S. (Shohoku Junior College, Kanagawa-ken, Japan). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The collection characteristics of 6 stage type Andersen samplers for biological particles were theoretically analyzed to give the relation of size distribution of original airborne particles and the collected biological particles. For the particles of range of 3 - 6 μm the geometric standard deviations show very uniform relations up to $\sigma g = 0.7$ which are very popular values for biological particles. For higher σg correction is needed. Geometric mean diameters did not show little changes for correction.

19158 (DOE/ER/60493—1-Vol.1, pp 713-717) **Sources and effects of microbiological indoor pollutants.** TerKonda, P.K. (Univ. of Missouri, Rolla). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

This paper presents a comprehensive evaluation of various sources of microbiological pollutants such as bacteria, molds and fungi, human pathogens, protozoa and house-dust mites prevalent in non-occupational indoor environments, and correlation of the effects these indoor pollutants have on human health. The main bacterial sources have been found to be human body, human respiratory tracts, air conditioners/humidifiers, flush toilets, furniture and floor coverings. Airborne transmission of microbiological indoor pollutants is achieved by the dispersion of carrier particles, and produces several patterns of illness including allergic rhinitis, bronchial asthma, hypersensitivity pneumonitis and Monday complaints.

19159 (DOE/ER/60493—1-Vol.1, pp 718-722) **Significance of fungi in indoor air: report of a Canadian working group.** Tobin, R.S.; Baranowski, E.; Gilman, A.P.; Kuiper-Goodman, T.; Miller, J.D.; Giddings, M. 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Although some insulation program in Canada have led to substantial savings in cost and energy, they have often been responsible for degradation of indoor air quality. Several studies have shown the presence of a number of species of fungi in indoor air that could contribute to ill health of residents. In 1985 the Dept. of National Health and Welfare established a working group to assess the extent to which microorganisms, especially fungi, could be a cause of home-related illness in Canada. This working group prepared a compilation of common indoor fungi, their toxins and metabolites and the possible adverse effects that could be expected. It

was concluded that fungi can be responsible for a wide range of human illness.

19160 (DOE/ER/60493—1-Vol.1, pp 723-727) **Health complaints and indoor molds in relation to moist problems in homes.** van Wageningen, N.; Waegemaekers, M.; Brunekreef, B.; Boleij, J. (Agricultural Univ. Wageningen, Netherlands). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Damp houses are very common in the Netherlands but rarely studied. The effect of living in damp homes versus dry homes on the prevalence of Chronic Non Specific Lung Disease in 202 children under 18 years of age and 328 parents was established with a questionnaire. Exposure to molds was quantified in the living rooms of a sample of 36 homes with modified Andersen samplers and compared with the occupants' answers on the occurrence of moist characteristics in their homes. The five most important characteristics were visible mold growth, damp stains, typical insects, bad smells and water content of the crawling space. Homes with at least two moist characteristics showed higher average spore counts, higher prevalences of respiratory complaints and odds ratio's statistically higher than 1 for women and children.

19161 (DOE/ER/60493—1-Vol.1, pp 3-7) **Sources and emission rates of organic chemical vapors in homes and buildings.** Ozkaynak, H.; Ryan, P.B.; Wallace, L.A.; Nelson, W.C.; Behar, J.V. (Harvard Univ., Cambridge, MA). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In recent years several efforts have been made to investigate the sources of volatile organic chemicals (VOCs) in offices and residential buildings. However, the largest data base by far has been compiled by NASA, who have tested the VOC emissions for over 5000 materials used in the space program. Many of these (paints, epoxies, pens, cosmetics, etc.) are available commercially and are used in homes and offices across the US. By utilizing this unique data base, stored on a personal computer, the authors calculated emission rates of ten common VOCs using the test results from a large number of materials and household products found in most US buildings. Ongoing analysis efforts using this important data set are also presented.

19162 (DOE/ER/60493—1-Vol.1, pp 8-15) **Organic emission measurements via small chamber testing.** Tichenor, B.A. (Environmental Protection Agency, Research Triangle Park, NC). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Organic emissions from a variety of indoor materials have been measured using small (166 liter) environmental test chambers. The following types of materials have been tested: adhesives, caulks, pressed wood products, floor waxes, paints, and solid insecticides. For each material, chamber concentration of organics has been determined for a range of environmental conditions (e.g., air exchange rate, temperature, and relative humidity). Various product loading ratios (are of sample/volume of chamber) have also been investigated. Emission rates for individual organic compounds, as well as total measured organics, were calculated. The effects of environmental variables on emission rates have been evaluated. Models are used to evaluate the effect of chamber walls and concentration on emission rates.

19163 (DOE/ER/60493—1-Vol.1, pp 16-21) **Volatile organic compounds from building materials in a simulated chamber study.** Berglund, B.; Johansson, I.; Lindvall, T. (Univ. of Stockholm, Sweden). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Building materials indoors emit volatile organic compounds. Do the materials also adsorb compounds so that an equilibrium with the indoor air is reached. Samples from the floor, walls, and ceiling were taken from one room in a 7-year old preschool-building. They were placed in a small climate chamber for a period of 41 days. The air in the room and in the chamber were analyzed by gas chromatography and mass spectrometry, and about 60 compounds were identified. Already the 1st day, the composition of organics in the room was re-established in the chamber. Since most of the compounds disappeared within 2 to 29 days, they are believed to have been adsorbed from the room air onto the material surfaces. During the last 10 days, 13 compounds remained at constant concentrations implying that they are representative for the materials themselves.

19164 (DOE/ER/60493—1-Vol.1, pp 22-26) **Bake-out of an office building.** Girman, J.; Alevantis, L.; Kulasingam, G.; Petreas, M.; Webber, L. (California Dept. of Health Services, Berkeley). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

To reduce concentrations of volatile organic compounds (VOC) emitted by building materials and furnishings, it has been recommended that new buildings undergo a bake-out. This paper reports the results of the bake-out of a newly renovated office building between 32°C and 39°C for 24 h at 1.59 h^{-1}. Based upon the 14 VOC quantified, the total VOC concentration increased more than 400% of the original concentration during the bake-out and was reduced to 71% of the original concentration after the bake-out.

19165 (DOE/ER/60493—1-Vol.1, pp 27-31) **Screening of household products for the emission of volatile organic compounds.** Knoeppel, H.; Schauenburg, H. (Commission of the European Communities, Ispra, Italy). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Ten household products have been screened for the emission of volatile organic compounds. Using Tenax sampling and analysis by combined gas chromatography-mass spectrometry (GC-MS) more than 80 single compounds or groups of isomers have been identified and semi-quantitative data on the initial emission rate (emission rate immediately after application) have been obtained. Products fall into two groups: those containing water as a main (80-90%) constituent and those without water. The initial emission rate of the first group ranged from 0.2 to 2 $\mu g\ cm^{-2}\ min^{-1}$ whereas the second group had higher emission rates up to 430 $\mu g\ cm^{-2}\ min^{-1}$. Products of the second group emit essentially hydrocarbons (alkanes, alkenes and terpenes) whereas most products of the first group emit oxygenated compounds among which are terpene alcohols and their acetates, aliphatic alcohols and esters and alkoxy-alcohols.

19166 (DOE/ER/60493—1-Vol.1, pp 32-36) **Prediction of the air concentration caused by the use of household products containing organic solvents.** Hansen, T.B. (Consulting Engineers and Planners, Lyngby, Denmark). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In 16 experiments 13 household products containing organic solvents are applied on surfaces under various circumstances. The parameters influencing the air concentration are measured or registered. The air concentration in the breathing zone of the operator is measured during application of the products. Furthermore the air concentration in the room is calculated using a model describing

the evaporation from the surface and the mixing in the room. There is a good correlation between the calculated and the measured concentration in the experiments with paint remover (methylene chloride) and paint and lacquer (white spirit) where the amount of products used is not too small and the room size and number of air changes in the room are not too large.

19167 (DOE/ER/60493—1-Vol.1, pp 37-42) **Indoor air pollution from volatile chemicals in water.** Andelman, J.B.; Wilder, L.C.; Myers, S.M. (Univ. of Pittsburgh, PA). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Various experimental parameters affecting the air concentrations of trichloroethylene and chloroform released from water were studied in a scaled-down laboratory bath-shower system to simulate the indoor inhalation exposures that can occur using water in the home contaminated with these volatile chemicals. Increased concentration in water, higher temperature, and smaller drop size in the shower increase the quantity volatilized in a given time. Reducing the air circulation through the chamber increases the air concentration as expected. In the shower system volatilization is substantial from the draining water, as well as the shower droplets. Volatilization from the bath water is slower than in the shower system.

19168 (DOE/ER/60493—1-Vol.1, pp 45-53) **Proposal of an Euro chamber for testing formaldehyde and other indoor air pollutants.** Gustafsson, H.N.O. 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A small scale method for testing emission of volatile pollutants from e.g. building materials is described. The method is illustrated with some measurements on formaldehyde. Based upon the experience of testing in small scale chambers dimensions of a full scale testing chamber is proposed. The chamber has the dimensions of a small room. Requirements on height and area of the smallest room (often a bedroom) in European countries based on national regulations are reviewed.

19169 (DOE/ER/60493—1-Vol.1, pp 54-58) **Procedure used to evaluate building materials and furnishings for a large office building.** Levin, H. (Univ. of California, Berkeley). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A building products and materials evaluation program was completed for a large California office building as part of a program to control indoor pollutant levels. Results from tests in an environmental chamber, bulk testing, and headspace sampling are consistent with each other and comparable to tests conducted elsewhere. The age of test materials appears significantly to affect emission rates and material chemical content. The work demonstrates useful procedures for building design, materials selections, construction, move-in procedures and mechanical ventilation system operations. Further work is needed to reduce costs and increase understanding of the interactions among materials in test chambers and buildings.

19170 (DOE/ER/60493—1-Vol.1, pp 59-62) **Pyrolysis of polymeric materials for construction, room decoration and insulation.** Ohrbach, K.H.; Matuschek, G.; Kettrup, A. (Univ. GH Paderborn, Germany, F.R.). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

With regard to the wide range of applications of polymers for construction, decoration as well as for electric and heat insulation it is necessary to have a good knowledge of the fire hazard, the fire performance and the toxicity of the combustion products of the materials and of the flame retardants. The authors have investigated the thermal degradation of commercial available polymers like polyurethane foam, polyvinyl chloride, polyamide 6, polypropylene, polystyrene and polyethylene and others by means of simultaneous TA-MS, PY-GC and combustion techniques. The identification of the decomposition products has been carried out in the gas phase and by desorption of the adsorbed compounds from the soot formed during the combustion process.

19171 (DOE/ER/60493—1-Vol.1, pp 63-68) **Developmental status of the indoor air source emissions database.** Reist, P.C.; Reaves, J.C.; White, J.B. (Univ. of North Carolina, Chapel Hill). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In a previous publication the concept of an indoor Air Source Emissions Database was explored and a first draft program presented for using this database. This program was written in dBase III and was intended for use with IBM and compatible personal computers. Although demonstrating the concept of such an approach to finding and utilizing the broadly-based literature on indoor air emission sources, there was still much to be done to increase program speed and versatility, and to remove operating bugs from the system. This paper reports on our progress towards these goals.

19172 (DOE/ER/60493—1-Vol.1, pp 69-73) **Formaldehyde in indoor air.** Rothweiler, H.; Knutti, R.; Schlatter, C. (Univ. of Zurich, Schwerzenbach, Switzerland). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Urea-formaldehyde foam insulation (UFFI) can cause raised indoor levels of formaldehyde (FA). Four laboratory methods to ascertain the factors that influence the FA release under realistic conditions were compared using freshly prepared foam and resin-suspension from various manufacturers. Contradictory results were found. Many factors seem to be responsible for the FA level actually occurring in a given situation, thus making it difficult to correctly predict FA levels in air. A case study, where the source of FA had to be found without removing or damaging any objects, illustrates the problems of a practical situation. The sealing-wax on the parquet floor was found to be the main FA source.

19173 (DOE/ER/60493—1-Vol.1, pp 74-78) **Portable gas chromatograph for identifying sources of volatile organics in indoor air.** Sheldon, L.S.; Michael, L.C.; Pellizzari, E.D.; Wallace, L. (Research Triangle Institute, Research Triangle Park, NC). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The purpose of this study was to investigate the feasibility of using a commercially-available, portable gas chromatograph (GC) for locating sources of volatile organics in the home. Based upon a review of performance parameters for the commercially-available instruments, a Photovac 10S series GC was selected for testing. Laboratory evaluations were performed to establish acceptable operating conditions and to demonstrate performance. This methodology was then evaluated in the field. Results of both laboratory and field evaluations are given.

19174 (DOE/ER/60493—1-Vol.1, pp 79-83) **Thermal insulation as a source of air pollution.** van der Wal, J.F.; Moons, A.M.M.; Steenlage, R. (Technology for Society, Delft, Netherlands). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Complaints about odors in buildings may be caused by moisture having penetrated into mineral wool used as thermal insulation in the cavity wall or under the roof. The complaints may occur particularly during hot weather. In laboratory experiments moist mineral wool produced the same unpleasant odor at 50°C. In samples from the air over the moist wool higher aliphatic aldehydes, ketones and aromatic aldehydes were detected. In air samples collected in rooms of buildings where complaints about odor had been made higher aliphatic aldehydes (n-hexanal-n-decanal) were detected, with concentrations between 1 and 50 $\mu g\ m^{-3}$ for each of these aldehydes. The penetration of moisture into mineral wool used for thermal insulation should be thus avoided.

19175 (DOE/ER/60493—1-Vol.1, pp 84-88) **Characterization of particle and organic emissions from unvented kerosene space heaters.** White, J.B.; Leaderer, B.P.; Boone, P.M.; Hammond, S.K. (Environmental Protection Agency, Research Triangle Park, NC). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Unvented kerosene space heaters are a major source of indoor air contaminants. This paper reports the results from the first phase of a three phase study to characterize and model particle and organic emissions from unvented kerosene space heaters. In the first phase (a screening phase) emissions from 12 heaters, covering a range of design types and BTU ratings, were evaluated during startup and three steady-state operating conditions (normal, low and high flame settings). Aerosol mass, size distribution, extractable mass, bioassay and trace element content as well as conventional gas (CO, NO/sub x/, etc.) measurements were made for all the heaters tested, while VOC's and semivolatiles measurements were made for a subsample of the heaters.

19176 (DOE/ER/60493—1-Vol.1, pp 89-94) **Carbonless copy paper as a potential non-building indoor irritant.** Wolkoff, P.; Nielsen, G.D. (Danish National Institute of Occupational Health, Hellerup, Denmark). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Six different carbonless copy papers and 2 carbonless copy forms were examined. Structural changes of the surfaces and transfer of particles to finger by paper handling were studied by scanning electron microscopy. The content of organic volatiles was examined and the relative amount of transferable volatiles by a standarized finger touch was measured and the content of free formaldehyde was also measured. Mice were exposed to the emission from carbonless copy papers and the sensory irritation was measured. The results showed that the microcapsules cleaved differently by a finger touch and particles could in some cases be transferred to the finger. The relative amount of transferable volatiles to the finger was different and paper brand specific. Some sheets contained large amounts of free formaldehyde. Some sheets gave permanent irritation in mice, while others showed only temporarily or no irritation. Experiments indicated that the irritant(s) was one or more volatile components possibly formaldehyde.

19177 (DOE/ER/60493—1-Vol.1, pp 102-106) **Occurrence of volatile organic compounds in the air of 500 homes in the Federal Republic of Germany.** Krause, C.; Mailahn, W.; Nagel, R.; Schulz, C.; Seifert, B.; Ullrich, D. (Institute for Water, Soil and Air Hygiene, Berlin, Germany, F.R.). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Passive samplers were exposed over 2 week periods between June 1985 and April 1986 to characterize the VOC burden of rooms in 500 German homes selected at random. Minimum, maximum and average concentrations as well as 50 and 90 percentiles are given for about half of the homes evaluated up to now, covering exposure periods in both summer and winter time. n-alkanes are found to be good indicators for the total VOC concentration.

19178 (DOE/ER/60493—1-Vol.1, pp 107-111) **Seasonal variation of concentrations of volatile organic compounds in selected German homes.** Seifert, B.; Schulz, C.; Steinbach, I.; Ullrich, D.; Mailahn, W. (Institute for Water, Soil and Air Hygiene, Berlin, Germany, F.R.). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Over the last few years, our knowledge of the occurrence of volatile organic compounds (VOC) in indoor air has been steadily increasing. However, the information on the seasonal variation of the VOC concentration levels remains scarce. To fill this gap, a one year study was started in April 1986 in which 12 homes are being followed. The homes include smokers' and non-smokers' households in old and new buildings. Activities and the use of products susceptible to generate VOC are recorded regularly in diaries. In one part of the study, VOC determinations are completed by measurements of ventilation rates. VOC belonging to the following classes are being determined after passive sampling over periods of 2 weeks: alkanes, aromatics, terpenes, halocarbons, and oxygen-containing compounds. Good assignments to the activities can be made for pollutants from intermittent sources.

19179 (DOE/ER/60493—1-Vol.1, pp 112-116) **Comparison of volitile organic levels between sites and seasons for the total exposure assessment methodology study.** Hartwell, T.D.; Pellizzari, E.D.; Perritt, R.L.; Whitmore, R.W.; Zelon, H.S.; Wallace, L. (Research Triangle Institute, Research Triangle Park, NC). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Concentrations of nine prevalent volatile organic compounds in breath, personal air, and outdoor air samples are compared for winter and summer in Bayoone and Elizabeth, New Jersey; winter and spring in Los Angeles and Pittsburg/Antioch, California; spring and Greensboro, North Carolina; and fall in Devils Lake, North Dakota.

19180 (DOE/ER/60493—1-Vol.1, pp 122-125) **Relation between soil pollution and indoor air pollution with volatile organic compounds.** Kliest, J.; Fast, T.; Boleij, J.S.M.; van de Wiel, H.; Bloemen, H. (Agricultural Univ. Wageningen, Netherlands). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The relation between soil pollution with volatile organic compounds and indoor air quality was examined. Measurements of the soil and indoor air were carried out in 77 houses built on different types of soil pollution. For comparison the same measurements were carried out in 20 reference houses. In 7 houses a clear influence of the soil pollution on the indoor air quality could be detected. Repeated measurements showed that the indoor air pollution was consistent, but highly variable in time. Statistical analyses indicated that the level of the ground water, the ventilation rate of the crawling space and the type of floor affected the relation. Model calculations for the prediction of indoor air concentrations from known soil concentrations gave poor results.

19181 (DOE/ER/60493—1-Vol.1, pp 126-130) **Sampling of VOC indoor under condition of high time resolution.** Wolkoff, P. (Danish National Institute of Occupational Health, Hellerup, Denmark). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Volatile organic compounds (VOC) were measured in one representative office in 14 town halls in 1984 as part of the Danish town hall study. The total VOC (TVOC) level was in the range from 0.1 to 1.2 mg/m^3 with a mean of 0.5 mg/m^3 (13 town halls). One 2 year old town hall had a TVOC of 32 mg/m^3, which de-

creased to 1 mg/m³ within 2 years. In 1985 VOCs and formaldehyde were measured in 2 offices in 4 selected town halls. The selection was based upon the presence of high or low work-related mucosal and general symptoms as seen from a questionnaire study. The results showed that TVOC may be strongly time dependent (activity and/or personnel). The ratio of TVOC(max) over TVOC(min) measured over one working day varied from 2 to 15. The results of formaldehyde showed that the concentration may change significantly (> 40%) during a working day; the mean concentration was 69 μg/m³. Continuous monitoring of total dust and TVOC showed that these follow each synchronously. The results lead to the conclusion that high time resolved sampling is important to be able to monitor maximum exposure levels of indoor pollutants because VOC and formaldehyde are activity dependent.

19182 (DOE/ER/60493—1-Vol.1, pp 139-143) **Performance of a thermally desorbable diffusion sampler for personal and indoor air monitoring.** de Bortoli, M.; Knoeppel, H.; Pecchio, E.; Vissers, H. (Joint Research Centre, Ispra, Italy). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A diffusion passive sampler suitable for large scale investigations on population exposure to volatile organic compounds (VOC) in indoor air has been designed and tested. The sampler is cheap, light and collects VOC at a flow of 4-8 cm³/h over one week, depending on the compound. The sampling flow is not influenced by air humidity or air velocity. Tenax and Carbotrap have been tested as adsorbents. The vapors are desorbed thermally and analyzed by gas-chromatography using commercial instruments. The sensitivity for one week exposure is about 1 μg/m³.

19183 (DOE/ER/60493—1-Vol.1, pp 144-148) **Characterization of volatile organic chemicals in public access buildings.** Jungers, R.H.; Sheldon, L.S. (Environmental Protection Agency, Research Triangle Park, NC). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The purpose of this study was the characterize indoor air pollutants in public access buildings as a function of aging and the effects of occupancy. Four building types were selected: (a) hospitals, (b) homes for the elderly, (c) schools, and (d) offices. New and old buildings of each available type were monitored. Old buildings were monitored while in use. New buildings were monitored upon completion of construction, again after furnishings were installed and then monitored after the building was occupied. Several locations within each building and the outdoors were monitored. A broad range of volatile organic compounds in both the vapor and particulate phase were determined. Emission rates of chemicals from building materials collected at the new office building were determined by using controlled chamber studies and are compared to the same chemicals observed during the monitoring phase.

19184 (DOE/ER/60493—1-Vol.1, pp 149-153) **Use of a passive sampler for the simultaneous determination of long-term ventilation rates and VOC concentrations.** Mailahn, W.; Seifert, B.; Ullrich, D. (Institute for Water, Soil and Air Hygiene, Berlin, Germany, F.R.). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

When interpreting seasonal variations of indoor concentrations of volatile organic compounds (VOC), the ventilation rate must be known. Therefore, a method has been developed which permits the simultaneous determination of the average ventilation rate and the concentration of VOC in a room over an integration period of 2 weeks with the same passive sampler. Hexafluorobenzene (HFB), a non-toxic substance, was chosen as the tracer not to interfere in the gas chromatographic analysis of VOC in indoor air. Emission rates of HFB sources were determined at various temperatures from 15 to 30°C. After a test of the procedure for sampling periods of 1 and 2 weeks in an experimental chamber at ventilation rates between 0.5 and 2 h^{-1}, it was successfully applied under field conditions.

19185 (DOE/ER/60493—1-Vol.1, pp 159-163) **Personal exposure due to solvent spillage on clothing.** Mierzwinski, S.; Breum, N.O.; Madsen, T.L. (Technical Univ. of Silesia, Poland). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

By an environmental chamber study the convective flow around a human being was simulated by a heated non-breathing thermal manikin. Following a simulated organic solvent spillage on the clothing the spatial uniformity of the breathing zone concentration of the manikin was described by simultaneous measurements of the concentration of volatile organic compounds at four positions within the breathing zone. This experiment was strongest concentration gradient measured was in calm air the concentration at the breast and at the lapel being 290 mg/m³ and 3 mg/m³, respectively. The non-uniformity of the concentration indicates a possible serious bias of the exposure estimate by the conventional sampling of the breathing zone concentration. The convective air velocity in calm air ranged 0.05-0.20 m/s within the breathing zone.

19186 (DOE/ER/60493—1-Vol.1, pp 164-168) **Time-resolved measurement of indoor exposure to volatile organic compounds.** Pleil, J.D.; Oliver, K.D.; McClenny, W.A. (Northrop Services, Inc., Research Triangle Park, NC). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Sampling is performed with in-situ sequential collection of whole-air using commercially available instrumentation modified to our specifications; analysis is performed by gas chromatography with a mass selective detector (GC/MSD) in the laboratory. The sampling instrument is portable and can be programmed to consecutively fill 12 stainless steel syringes (150 cc each) at a rate of 2 to 90 min/sample. The GC/MSD method is fully automated to sequentially analyze the 12 springe samples and generate reports of concentrations of 40 specific volatile organic compounds. This sampling/analysis method is tested for sample integrity and then used to document the time-dependent fluctuations of indoor-air in three situations: bathroom during shower; automobile while driving; and office area near laboratories.

19187 (DOE/ER/60493—1-Vol.1, pp 169-173) **Investigation of volatile organic air contaminants in the indoor manufactured housing environment.** Sterling, D.A.; Stock, T.H. (IIT Research Institute, Chicago, IL). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The influences of environmental, architectural, and temporal factors on the presence of volatile organic compounds were investigated in a matched pair of mobile homes, one with electric heating and cooking utilities and the other with propane gas utilities. Over a 14-month period, formaldehyde levels decreased 33%. Daily fluctuations of 20% to 40% were observed. An increase in indoor temperature of 8°C doubled the measured formaldehyde concentration. Opening windows resulted in decreases of indoor formaldehyde levels of up to 50%. The presence and concentration of selected volatile organic compounds was influenced most by occupant activities.

19188 (DOE/ER/60493—1-Vol.1, pp 174-178) **Assessment of the indoor air concentration of an organic substance emitted from a continuous source using methyl benzoate as an example.** Ullrich, D.; Zaifang, L.; Seifert, B. (Institute for Water, Soil and Air Hygiene, Berlin, Germany, F.R.). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The described general procedure for the assessment of indoor air concentration of a volatile organic compound includes the calculation of concentrations from emission data and the verification of this calculation by suited sampling and analytical procedures under laboratory and field conditions. These steps are complemented by the collection of information regarding the toxicological implications of the observed concentration levels. Methyl benzoate, an odorous compound occurring in a great number of German households, is used as an example. Concentrations ranging from 2 to 15 $\mu g/m^3$ were observed, fitting well a calculated range of 0.13 to 67 $\mu g/m^3$.

19189 (DOE/ER/60493—1-Vol.1, pp 179-182) **Organic solvents in the indoor air of ten small screen printing plants and surrounding houses.** Verhoeff, A.; Suk, H.; van Wijnen, J. (Municipal Health Service, Amsterdam, Netherlands). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The presence of organic solvents was investigated by means of environmental monitoring of the indoor air during one work-week each in ten selected small screen printing plants and their surrounding houses, situated in the inner city of Amsterdam. In the indoor air of the screen printing plants 14 to 17 organic solvents were identified; in the indoor air of the houses above the plants none to fifteen organic compounds were identified. Screen printing plants situated in moderately maintained buildings with wooden floors and ceilings were a source of organic solvents for the houses situated above. The concentrations in these houses were distinctly higher in comparison with the concentrations in the referent houses. Screen printing plants situated in well maintained buildings with wooden floors and ceilings or in concrete new buildings were not demonstrable source of organic solvents. In the houses on the first floors above the screen printing plants, the highest concentrations were found (e.g., toluene, 25 mg/m^3, time weighted average 8-hours).

19190 (DOE/ER/60493—1-Vol.1, pp 183-187) **Volatile organic compounds in 600 US homes: major sources of personal exposure.** Wallace, L.; Clayton, C.A. (Environmental Protection Agency, Washington, DC). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The US EPA carried out the Total Exposure Assessment Methodology (TEAM) Study (1980-1985) on 600 subjects in five cities representing a total population of more than 700,000 persons. Personal exposures to all prevalent target compounds exceeded outdoor concentrations. Major sources were smoking (benzene, styrene, xylenes, and octane); using hot water (chloroform); wearing dry-cleaned cloths (tetrachloroethylene); and using moth crystals or room air deodorants (para-dichlorobenzene). Eleven of 14 occupations also showed elevated exposures to one or more chemicals (particularly aromatics). Auto related activities (lengthy commuting, filling gas tanks) were associated with increased exposures to several aromatics. Breath concentrations were significantly associated with personal air exposures but not with outdoor concentrations. Residence in major chemical manufacturing and petroleum refining areas did not significantly affect personal exposures.

19191 (DOE/ER/60493—1-Vol.1, pp 188-192) **Volatile organic chemicals in 10 public-access buildings.** Wallace, L.; Jungers, R.; Sheldon, L.; Pellizzari, E. (Environmental Protection Agency, Washington, DC). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The US EPA carried out studies of indoor air quality in 10 buildings. Qualitative analysis identified over 200 aromatics, halogens, esters, alcohols, phenols, ethers, ketones, aldehydes, and epoxides, in addition to several hundred aliphatic hydrocarbons. The total organic load for nine buildings exceeded outdoor levels, by factors of up to 100 for new buildings. New buildings had high levels of eight organics (e.g., decane, xylenes, 1,1,1-trichloroethane). Levels in three new buildings declined with half-lives of 2-8 weeks. For some chemicals (e.g., trichloroethylene) levels increased with time, indicating the influence of consumer products or activities.

19192 (DOE/ER/60493—1-Vol.1, pp 195-199) **Non-occupational exposure to household pesticides.** Lewis, R.G.; Bond, A.E. (Environmental Protection Agency, Research Triangle Park, NC). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The US Environmental Protection Agency is conducting a study to develop and validate monitoring methods needed for the determination of human exposure to common household pesticides. The primary objective is to obtain an estimation of the cumulative frequency of non-occupational exposures to home and garden pesticides through the air, dermal, drinking water, and dietary routes. In a nine-home pilot study designed to test methodology, 22 of 28 of the most commonly used household pesticides were detected. Five of these were measured in the air in the majority of the households at concentrations ranging up to several $\mu g/m^3$. Personal air measurements suggested that 80% of the total respiratory exposures resulted from indoor air. Subsequent to the pilot study, a large-scale, multi-season monitoring program involving up to 175 homes in a high-use southern US city and about 85 homes in a low-use northern US city was initiated.

19193 (DOE/ER/60493—1-Vol.1, pp 200-204) **Airborne termiticide levels in houses on United States Air Force installations.** Lillie, T.H.; Barnes, E.S. (Air Force School of Aerospace Medicine, Brooks AFB, TX). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The indoor air of 5038 houses on US Air Force installations was examined, from 1979 to 1983, to determine the concentration of chlordane, a commonly used termiticide. Chlordane was detected in the air of 44% (2208) of the houses, and the probability of contamination was greater in houses constructed over a crawl space than in those constructed on a slab. The incidence of airborne contamination was greater in houses built on soil treated after construction than in those built on soil treated before construction. The chlordane concentration was greater than or equal to 5 $\mu g/m^3$ in 4.7% (236) of the houses.

19194 (DOE/ER/60493—1-Vol.1, pp 205-209) **Indoor airborne concentrations of termiticides of Department of the Army family housing.** Olds, K.L. (Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Because of known problems of termiticide contamination of Dept. of Defense housing, the US Army developed a sampling plan to evaluate over 20,000 slab construction housing units. Housing units were sampled using Chromosorb 102 collection tubes and analyses were done by gas-liquid chromatography for a broad range of pesticides to include termiticides and most indoor-use pesticides. Less than 1% of the housing units sampled were shown to be contaminated. No correlation was found between airborne concentrations and environmental factors such as indoor air temperature, barometric pressure and relative humidity.

19195 (DOE/ER/60493—1-Vol.1, pp 210-214) **Analysis of low volatile (> C_{15}) and particle bound indoor pollutants: assessment of a sensitive method and first result.** Oehme, M.; Knoeppel, H. (Norwegian Institute of Air Research, Lillestrom). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Combined glass fiber filter and polyurethane foam (PUF) plug sampling followed by low temperature extraction, HPLC preseparation and capillary GC-MS analysis has been used to identify organic compounds of low volatility in a complex indoor air sample. The most noteworthy results are: (a) about 85% of the total recovered organic material was present in the vapor phase whereas only 15% was associated with particulate matter; (b) the most important qualitative differences between the indoor and typical outdoor samples were detected in the vapor phase fraction; (c) among the species normally not found in ambient air or found at considerably lower concentrations are biocides, phthalates, aliphatic aldehydes, and silicones.

19196 (DOE/ER/60493—1-Vol.1, pp 215-219) **Comparison of the organic chemical composition of indoor aerosols during woodburning and non-woodburning periods.** Daisey, J.M.; Spengler, J.D.; Kaarakka, P. (Lawrence Berkeley Lab., CA). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Concentrations of respirable particulate matter (RSP), extractable organic matter (EOM) and polycyclic aromatic hydrocarbons (PAH) were compared in 7 Wisconsin homes during woodburning and non-woodburning periods. No difference was observed between RSP concentrations during the two periods. Concentrations of EOM, however, were approximately two times higher and of PAH were 2-46 times higher during the periods when the wood stoves were in operation.

19197 (DOE/ER/60493—1-Vol.1, pp 220-224) **Pentachlorophenol containing wood preservatives analyses and evaluation.** Krause, C.; Englert, N.; Dube, P. (Institute for Water, Soil and Air Hygiene, Berlin, Germany, F.R.). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Until 1977, wood preservative formulations containing pentachlorophenol (PCP) and lindane were freely used for domestic purposes in the Federal Republic of Germany. In 90% of the 217 households examined, such formulations were applied and the quantity used per house varied from 25 to 1000 g for lindane and 50 g to 10 kg for PCP (including other contaminating chemicals). Consequently, these wood preservative ingredients were increasingly detected both quantitatively and qualitatively, in body fluids and in the environment of persons living in such households. The median concentration of PCP in urine was 29 μg/l for the group exposed to wood preservatives as compared to 10 μg/l in the non-exposed group. Indoor air samples from 104 examined households showed a median level of 5 μg PCP/m^3 - the highest vale recorded was bout 25 μg PCP/m^3. Dust samples collected from vacuum cleaners in wood preservative user households showed a median value of 13 μg PCP/g as compared to only 0.008 μg PCP/g in samples from the control group. PCP concentration in dust samples corresponded well with urinary PCP levels.

19198 (DOE/ER/60493—1-Vol.1, pp 227-229) **Detection of small concentrations of pentachlorophenol in air.** Huempel, P.; Keller, R. (Medizinische Universitaet zu Luebeck, Germany, F.R.). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A modified analytical method according to Gebefuegi and Parlar for the determination of small pentachlorophenol concentrations in air is described. This method is based essentially on the absorption of the pentachlorophenol out of the air into a diluted solution of potash, derivation to the pentachlorophenoacetate, extraction and subsequent quantitative evaluation by means of capillary gas chromatography under application of the ECD-detection. The technique offers the advantage of a relatively simple labor-technical execution and a low detection limit of 0,020 μg of pentachlorophenol/m^3 of air in a suction volume of air of 300 l.

19199 (DOE/ER/60493—1-Vol.1, pp 230-234) **Monitoring of air levels of termiticides in homes in the United States.** Jaquith, D.A.; McDavit, W.M.; Reinert, J.C. 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In 1984 the Environmental Protection Agency required the registrants of the principal pesticides used for subterranean termite control to design and carry out monitoring studies of air levels of pesticides in homes treated according to label directions. These studies are being conducted in homes of different construction types (crawlspace, plenum, basement, slab) and in different geographical locations. For all termiticides studied, air levels appear to remain constant from a few days after application to 90 days post treatment. This is true for most construction types and for first floor rooms. Basements have significantly higher levels of pesticide and these levels decrease during the first 90 days after treatment. Monitoring will continue for one year post-application.

19200 (DOE/ER/60493—1-Vol.1, pp 235-238) **Phenol levels in indoor air.** Kalinic, N.; Sega, K.; Krsak, J.; Sisovic, A. (Institute for Medical Research and Occupational Health, Zagreb, Yugoslavia). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In the course of 1983 and 1984 concentrations of phenol in the air were measured over 7 to 12 days in six office buildings (simultaneously indoors and outdoors) and in ten kindergartens and eight schools. Integrated 24-hour samples of phenol and its homologues were collected, stored and analyzed using Lahmann's method. The results indicate that on the whole phenol concentrations are not disturbing.

19201 (DOE/ER/60493—1-Vol.1, pp 243-247) **Tradescantia-micronucleus (Trad-MCN) bioassay - a promising indoor air pollution monitoring system.** Ma, T.H.; Harris, M.M. (Western Illinois Univ., Macomb, IL). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Tradescantia-micronucleus (Trad-MCN) assay, an efficient short-term test for environmental clastogens, has been utilized for in situ air pollutant monitoring for the last ten years. Laboratory tests on pure gaseous agents such as sulfur dioxide, nitrogen oxides, hydrozoic acid, EDB, EMS, ozone, and mixtures such as fumes of diesel engine exhaust, pesticides, and air fresheners proved that this assay is highly sensitive and reliable. Current study on the indoor atmosphere ranging from smoker's office, smokerium in school, dry cleaner's shop, trailer and homes gave positive responses in most tests. Trad-MCN assay is a promising indoor air monitoring system which provides the first alert of the presence of pollutants in homes, offices and work places. The wide application of this test in the grass-root level will have a far reaching educational value in the society.

19202 (DOE/ER/60493—1-Vol.1, pp 248-251) **Termiticides in indoor environments.** Qazi, A.H. (Dept. of Health, South Charleston, WV). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

To control subterranean termites inside the dwellings, aldrin, chlordane and heptachlor have been used most frequently in the United States. Among these, chlordane has been the chemical of choice for termite control. All three termiticides are cyclodiene pesticides and primarily affect central nervous system, liver and chloracne in more susceptible individuals. A well researched method was chosen to investigate complaints of termiticide contamination of dwellings in the State of West Virginia. Termiticide levels in twenty-seven homes and public buildings were determined. Of these, seventy-five percent showed measurable termiticide concentration while 18.5% had levels exceeding the NAS and the WHO Guidelines. Recommendations were made to eliminate or to reduce the existing termiticide levels inside the dwellings to lower levels.

19203 (DOE/ER/60493—1-Vol.1, pp 252-256) **Quantification of sorption effects for selected organic substances present in indoor air.** Seifert, B.; Schmahl, H.J. (Institute for Water, Soil and Air Hygiene, Berlin, Germany, F.R.). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The sorption behavior of lindane and 20 volatile organic compounds of different polarity and boiling points was studied in a 1 m^3 glass chamber at concentration levels between 5 and 35 mg/m^3 with plywood and carpeting (polyamide and wool) serving as representatives of materials used frequently indoors. Only during the first 2 to 3 hours after starting the experiment were the concentration levels in the air determined by the air exchange rate, whereas later sorption phenomena were dominant, especially in the case of more polar compounds like hexanal and n-butanol. Additional experiments with formaldehyde and lindane aimed at studying sorption processes with textiles under close-to-real-life conditions showed that formaldehyde was eliminated rapidly, whereas lindane concentration remained high over several days.

19204 (DOE/ER/60493—1-Vol.1, pp 257-261) **Indoor screening of polycyclic organic pollutants: a field study in seventy homes.** Vo-Dinh, T.; Miller, G.H.; White, D.A.; Hawthorne, A.R.; Mage, D.T. (Oak Ridge National Lab., TN). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

This paper describes the use of a simple approach developed for screening polynuclear aromatic (PNA) organic pollutants in indoor environments. The screening method is based on a synchronous luminescence (SL) technique and a room temperature phosphorescence (RTP)-based dosimeter. The SL technique was used to analyze air samples collected by active samplers whereas the RTP passive dosimeters were used to monitor PNA vapors. Results of the field study conducted in 70 homes in the United States (Alabama, Georgia, Mississippi and Tennessee) are discussed. Examples will illustrate the effects of various indoor emission sources on the levels of pollutants found in indoor samples. The results of this field study indicate that this procedure provides a practical and cost-effective tool to screen air samples for PNA pollutant content and reduces the number, and cost, of elaborate detailed analyses for indoor air quality field studies.

19205 (DOE/ER/60493—1-Vol.1, pp 262-264) **Occurrence of lindane and PCP in Bavarian buildings.** Zsolnay, A.; Gebefuegi, I.; Korte, F. (Institut fuer Oekologische Chemie, Neuherberg, Germany, F.R.). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A total of 201 samples from various buildings in Bavaria were analyzed for the biocides Lindane and PCP. Samples consisted of air, dust, wood, carpeting, etc. The samples were taken from private apartments, private houses, and public buildings. They were located in cities and the countryside. Participants submitted a questionnaire to determine, among other things, whether or not they were smokers. The only covariation found was that dust samples from smokers' homes had a significantly higher concentration of PCP.

19206 (DOE/ER/60493—1-Vol.1, pp 265-270) **Use of factorial design to estimate synergistic effects in the environment.** Zsolnay, A.; Gebefuegi, I.; Korte, F. (Institut fuer Oekologische Chemie, Neuherberg, Germany, F.R.). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In environmental studies, experiments are often done under controlled conditions to develop a better understanding of how chemicals are transported and distributed. This is complicated by the fact that even in indoor environments, with their sharply defined boundaries, numerous variables need to be considered, and, because of possible synergistic effects or interactions, they need to be considered simultaneously. Nevertheless, there is a tendency to make model investigations on a one-variable-at-a-time basis, assuming that the effects of the variables on the phenomenon of interest are additive. Here, a relatively simple approach is presented. It is based on the concept of factorial design, which is used often in process development but has been applied seldom in environmental studies. And since all the variables are considered simultaneously, not only can the main effects of the individual variables be estimated, but also the presence or absence of a synergistic effect can be detected. The application of this approach was tested on a model study, investigating the transfer of the biocide Lindane (γ-hexachlorocyclohexane) from a treated wood surface to cotton fabric. There is reason to believe that possible toxic effects are less likely to be caused by the incorporation of biocides through ambient air than by absorption from clothing or bedding, which have adsorbed and concentrated these materials.

19207 (DOE/ER/60493—1-Vol.1, pp 273-277) **Macromodel for assessing indoor exposures to combustion-generated pollutants.** Traynor, G.W.; Aceti, J.C.; Apte, M.G.; Smith, B.V.; Green, L.L.; Smith-Reiser, A.; Novak, K.M.; Moses, D.O. (Lawrence Berkeley Lab., CA). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A macromodel for assessing indoor exposures to combustion-generated pollutants is currently under development. Major combustion sources to be modeled include cigarette smoking, gas appliances, unvented kerosene space heaters, and wood stoves. Major inputs to the macromodel include source market penetrations, source usage information, pollutant emission rates, source ventilation characteristics, building stock characteristics, and outdoor pollutant concentrations. The distributions of input parameters are combined using deterministic and Monte Carlo simulation techniques applied to equations primarily based on mass-balance principles. Outputs from the model include distributions of indoor pollutant concentrations versus geographic location, climate, time of year, and/or sources. The macromodel can be used to identify high-exposure populations and information gaps and to conduct parameter sensitivity analyses.

19208 (DOE/ER/60493—1-Vol.1, pp 278-282) **Continuous nitrogen dioxide monitoring during cooking and commuting: personal and stationary exposures.** Harlos, H.P.; Spengler, J.D.; Billick, I. (Harvard School of Public Health, Boston, MA). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Nitrogen dioxide (NO_2) exposures of people engaged in cooking and commuting were continuously monitored with a small, electrochemical-cell instrument and a compact data logger. Time-

averaging of 5 seconds and longer is used to assess peak exposures and the distribution of continuous exposure. Subjects were monitored in their homes while using gas cooking ranges and during commuting. For homes, simultaneous stationary and personal measurements are compared. Commuting exposures were similar to well-mixed ambient NO_2 levels. Cooking exposures were heavily right-skewed, multimodel distributions with highest peak concentrations associated with oven door use.

19209 (DOE/ER/60493—1-Vol.1, pp 283-287) **Determinants of carbon monoxide exposure in residences of ischemic heart disease patients.** Colome, S.D.; Lambert, W.E.; Castaneda, N. (Univ. of California, Irvine). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Over 40 subjects with ischemic heart disease were selected to carry portable carbon monoxide (CO) monitors for three to five twenty-four hour periods and maintain a diary of locations and activities. Minute-by-minute personal CO exposures were recorded and time-weighted averages were calculated for indoor microenvironments, including the bedroom, living room, kitchen, and outdoor areas immediately surrounding the residence. Passive monitoring for nitrogen dioxide (NO_2) was performed to obtain a one-week average concentration during the same season in a subset of 23 residences. Subjects completed questionnaires on sources, source use, home structure, and habits that may affect indoor pollutant exposure. One-week average ventilation rates were measured using a passive diffusion and collection method. Indoor personal CO exposures were found to be significantly associated with one-week NO_2 concentrations, indicating some stability in wintertime indoor exposure to combustion gases. Residences with high indoor CO concentrations may be accurately identified by less expensive, passive monitoring for the co-pollutant NO_2.

19210 (DOE/ER/60493—1-Vol.1, pp 311-315) **Reaction decay of nitrogen dioxide.** Billick, I.H.; Nagda, N.L. (Gas Research Institute, Chicago, IL). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

To address the gap in knowledge of factors related to decay rates for nitrogen dioxide (NO_2), the Gas Research Institute (GRI) has sponsored experimental work in a laboratory chamber and in two unoccupied research houses. The results of these experiments, coupled with limited work of other investigators, have shown that (1) reactivity of different materials varies from 0 to 8 h^{-1} or more; (2) effects of humidity on reaction decay are inconsistent; (3) the longer the duration of appliance operation, the smaller are the values for the rate constant; and (4) production of NO sometimes accompanies the decay of NO_2.

19211 (DOE/ER/60493—1-Vol.1, pp 316-320) **Statistical analysis of published gas stove emission factors for CO, NO, and NO_2.** Borrazzo, J.E.; Davidson, C.I.; Hendrickson, C.T. (Carnegie Mellon Univ., Pittsburgh, PA). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Published emission factors for CO, NO, NO_2 have been summarized. Of the factors studied, stove differences and combustion adjustment are the most important in explaining the observed variance in emission factors. Limited data also suggest that CO emission factors may vary significantly with gas flow rate, while those for NO and NO_2 exhibit less variability.

19212 (DOE/ER/60493—1-Vol.1, pp 321-325) **Determination of NO_2 loss rates from concentration measurements in an occupied urban residence.** Borrazzo, J.E.; Peters, C.; Peck, S.; Davidson, C.I. (Carnegie Mellon Univ., Pittsburgh, PA). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Concentrations of NO and NO_2 have been monitored over a period of seven months in an occupied townhouse. Preliminary analysis indicates that calculation of reaction rates for NO_2 is more sensitive to sampling location than calculation of infiltration rates using NO concentration data. This is related to the presence of spatial concentration gradients which undermine the validity of a one-compartment mass-balance model.

19213 (DOE/ER/60493—1-Vol.1, pp 326-329) **Emissions from conventional kerosene stove used in Indian kitchen.** Dave, J.M. (Jawaharlal Nehru Univ., New Delhi, India). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Emissions from a traditional stove as measured for open flame per litre of kerosene used are NO - 32.4 mg, NO_2 - 61.56 mg; CO - 341 mg, SO_2 - 3560 mg, BaP - 3.8 mg for open flames and with pan they are NO - 23.6 mg, NO_2 - 42.8 mg, CO - 458 mg, SO_2 - 3560 mg. The air quality in 18.6 m^3 kitchen with no ventilation were NO - 32.4 to 47.8 ug/m^3 NO_2 - 61.5 to 106.7 ug, CO - 8417.5 to 11,442 ug, SO_2 - 12,210.8 to 12,734.7 ug, BaP - 43 to 52 ng per meter cube of air each. These are extremely high for the safety of the housewife even though they are much lower than the anticipated values. These stoves should be used only with well ventilated kitchen or with hood and chimney to control air quality in kitchen.

19214 (DOE/ER/60493—1-Vol.1, pp 330-332) **Interaction of nitrogen oxides with particles: chemical transformation on activated carbon and alumina surfaces.** Gundel, L.A.; Somorjai, N.; Novakov, T. (Lawrence Berkeley Lab., CA). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

This report describes laboratory studies of the interaction of NO_2 with activated carbon and alumina particles. Besides monitoring NO and NO_2, we determined concentrations of nitrite and nitrate ions on the particles. The influence of water vapor on the distribution of reaction products has also been studied. The results have been interpreted with a mechanism that may apply to other kinds of indoor surfaces.

19215 (DOE/ER/60493—1-Vol.1, pp 333-337) **Two-zone modeling for air exchange rates and NO_2 source and decay rates in a southern California residential indoor air quality study.** Hoogendyk, C.G.; Dietz, R.N.; D'Ottavio, T.W.; Goodrich, R.W. (Brookhaven National Lab., Upton, NY). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1). Contract AC02-76CH00016.

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

BNL/AIMS and NO_2 measurements were applied to 640 homes in Southern California during Mar 1984, Jul 1984, and Jan 1985. Whole house AERs had median values of 0.84/h, 1.5/h and 0.55/h respectively. NO_2 decay rates for 18 all-electric homes, and for the bedroom zone across all homes, had a median of about 0.6/h and did not vary noticeably among test periods. Median NO_2 source rates for the living zone (kitchen and living room) were 10.6 mg/h, 12.3 mg/h and 7.4 mg/h, while medians for the bedroom zone were all 0 mg/h. Outdoor sources made the largest contribution to NO_2 in the bedroom zone, while indoor sources were marginally more important than outdoor in the living zone (Southern California has high concentrations of outdoor NO_2).

19216 (DOE/ER/60493—1-Vol.1, pp 338-342) **Effect of level of air infiltration on CO and NO emissions from unvented gas space heaters in mass-balance (chamber) measurements.** Macriss, R.A.; Elkins, R.H.; Billick, I.H. (Institute of Gas Technology, Chicago, IL). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The effect of chamber air infiltration rate on NO and CO emission rates has been derived from tests with a natural-gas-fired, convective unvented space heater (UVGSH). Measurements were carried out in IGT's test chamber using a methodology employed by the Lawrence Berkeley Laboratory (LBL) for measuring emissions from these heaters. The heater had been previously tested in the LBL test chamber by a methodology that requires an air infiltration rate of 0.5 acph to be maintained in the chamber and a specific protocol that allows determination of the effect of long-term heater operation on emissions. The IGT tests were performed by the LBL methodology but a 3 different air infiltration rates (0.5, 4 and 10 acph). The IGT results suggest that the level of chamber air vitiation, due to low air infiltration, can severely affect CO emissions resulting in unrealistically high CO emission rates. A lesser effect was observed on NO emissions, and NO_2 emissions were unaffected, at a relatively low (0.5 acph) chamber air infiltration rate.

19217 (DOE/ER/60493—1-Vol.1, pp 343-348) **Field measurements of NO_2 gas range-top burner emission rates.** Moschandreas, D.J.; Relwani, S.M. (IIT Research Institute, Chicago, IL). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

This paper discusses a field experimental technique used, the data base generated, and the distribution of NO_2 emission rates from range-top burners measured in residences throughout the Chicago metropolitan area. The development work for the field study was performed in an environmental test chamber using one gas range. The field technique was compared to real-time measurements using stoichiometric (direct method) principles. A total of 25 gas ranges were evaluated for NO_2 emission rates. The experimenters concluded that there are no major differences between the field experimental technique used and the direct method for NO_2 emission rate measurements. The measured NO_2 emission rates from the 25 gas ranges vary considerably, with some indication of dependence on the age of the gas range.

19218 (DOE/ER/60493—1-Vol.1, pp 349-353) **Limits of carbon monoxide and dioxide from unvented instantaneous water heaters.** Naudeix, D. 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In France, hot water for kitchens and showers can often be provided by instant water heaters. These are relatively low rated (8.72 kW). Their design allows simple installation : two connections, one to the water supply, one to the gas supply and two flue system ... But in a confined location, the production of carbon dioxide during the combustion may alter the way the burner works leading to excess emission of carbon monoxide. The same thing happens when the heat exchanger becomes dirty through lack of maintenance, which prevents a good air supply to the combustion chamber. A device which works with a flame sensitive to carbon dioxide in combustion air can then stop the burner.

19219 (DOE/ER/60493—1-Vol.1, pp 354-358) **Composition and size distribution of residential wood smoke particles.** Rau, J.A.; Huntzicker, J.J. (Oregon Graduate Center, Beaverton). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Residential wood combustion (RWC) emissions are an important source of indoor particulate pollution. To gain a better understanding of this source, detailed chemical and physical measurements were made of RWC aerosols from stove smoke plumes which had been cooled and diluted by ambient air. Particle organic (OC) and elemental (EC) carbon and trace element composition were determined for emissions from hot and cool burning stoves and from fireplaces.

19220 (DOE/ER/60493—1-Vol.1, pp 359-364) **Solid and gaseous emissions from wood fired boilers.** Rawe, R. (Muenster Technical College, Germany, F.R.). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Experimental studies were made to investigate solid and gaseous emissions of typical domestic boilers as a function of boiler design and operating conditions, i.e. fuel loading, primary and secondary air supply, boiler water temperature etc. Special attention was paid to the measurement of solid particle emissions, as they are laid down in West German legislation.

19221 (DOE/ER/60493—1-Vol.1, pp 365-370) **Vitiation of combustion air and its effect on the performance of a gas stove.** Sharma, S.P.; Parikh, P.P.; Baruah, P.C. (Indian Institute of Technology, Bombay). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Combustion air that is deficient in oxygen is said to be vitated. Different levels of vitiation were created around a gas stove by placing it centrally in a perspex sided enclosure called the vitation chamber. In the combustion diagram, the burner port loading and primary aeration were plotted to get the yellow-tipping and blow-off curves of multiport burners as also the operating point of the burner on the same diagram. The blow-off stability was significantly affected by vitiation by CO_2 and the least in case of vitiation by N_2, the water vapor having an intermediate effect. Quantitatively, the effect of vitation, even by N_2, on the blow-off stability of LPG-air flames is significant enough to cause performance problems for combustion appliances at levels of vitiations that may be encountered in practice.

19222 (DOE/ER/60493—1-Vol.1, pp 371-375) **Rates and mechanisms of NO_2 removal from indoor air by residential materials.** Spicer, C.W.; Coutant, R.W.; Ward, G.F.; Joseph, D.W.; Gaynor, A.J.; Billick, I.H. (Battelle Columbus Division, OH). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Recent studies have shown that NO_2 is removed from indoor air more rapidly than by air exchange alone. The relative efficiencies for NO_2 removal of a large number of materials are presented, along with a discussion of the factors which influence the removal process. This work has demonstrated that indoor reactions represent a significant unintended sink for NO_2, and that these reactions currently are effecting a considerable degree of control of indoor NO_2 levels. It seems likely that this control could be enhanced by judicious selection of furnishings and construction materials. Improved understanding of the rates and mechanisms of the removal process will permit optimization of the process for indoor air quality improvement.

19223 (DOE/ER/60493—1-Vol.1, pp 376-380) **Removal of nitrogen dioxide by interior materials.** Yanagisawa, Y.; Fasano, A.M.; Spengler, J.D.; Ryan, P.B.; Billick, I.H. (Harvard School of Public Health, Boston, MA). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The adsorption rate of NO_2 by interior materials has been investigated by various researchers. Several commonly used building

materials (cement, gypsum board, masonite) were packed into glass tubes, then exposed to an air stream containing known concentrations of NO_2. During the experiments, temperature, relative humidity and air flow rate were maintained at constant levels. The adsorption rate and adsorption capacity for NO_2 were determined by sampling the air stream after it passed over the building material. Preliminary results suggest that both rate and capacity are strongly affected by relative humidity.

19224 (DOE/ER/60493—1-Vol.1, pp 383-389) **Indoor-outdoor nitrogen dioxide concentration ratios for homes with gas and electric cooking.** Atkins, D.H.F.; Law, D.V. (Environmental and Medical Sciences Division, Harwell, England). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Following the publication of the EEC Directive on Nitrogen Dioxide, experiments have been carried out to assess the protection afforded by houses against this pollutant. Passive diffusion tube samplers originally developed for the indoor measurement of NO_2 have been shown to be suitable for outdoor use. Batches of three of these samplers were exposed indoors (kitchen, living room and bedroom) and outdoors (front, back and side of the house) at two houses containing no sources of NO_2 and at one house with a gas cooker for consecutive two-week sampling periods over fifteen months. Single two-week measurement were also made at 37 other houses. For houses with no sources of NO_2, ratios of indoor-outdoor concentrations should a pronounced seasonal effect with high values in the summer and low in the winter. These ratios were apparently independent of ambient NO_2 concentrations. For houses with gas cooking indoor-outdoor ratios were always > 1. In the house where measurements were made over 15 months the average kitchen concentration was 107 ppb.

19225 (DOE/ER/60493—1-Vol.1, pp 390-394) **Evaluation of housing and appliance characteristics associated with elevated indoor levels of nitrogen dioxide.** Baker, P.E.; Cunningham, S.J.; Becker, E.W.; Colome, S.D.; Wilson, A.L. (Southern California Gas Co., Los Angeles). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

During the Residential Indoor Air Quality Characterization Study of Nitrogen Dioxide (NO_2), sponsored by the Southern California Gas Company, a number of residences were identified as having indoor NO_2 concentrations higher than expected. Due to this finding, fifty homes recording the highest indoor levels were selected for further study. Site visits with a portable real time nitrogen dioxide monitor were conducted to identify the sources of elevated concentrations. A smoke test was also used to check appliances venting. Each visit took one to four hours and involved a detailed operating inspection and servicing of each natural gas-fired appliance.

19226 (DOE/ER/60493—1-Vol.1, pp 395-399) **Overview of the residential indoor air quality characterization study of nitrogen dioxide.** Baker, P.E.; Cunningham, S.J.; Becker, E.W.; Colome, S.D.; Wilson, A.L. (Souther California Gas Company, Los Angeles). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The Southern California Gas Company Characterization Study evaluates factors that influence residential indoor nitrogen dioxide concentrations in a temperate geographical region with natural gas appliances and housing construction consistent with a mild climate. Residential homes in the Los Angeles basin were identified by stratified cluster sampling. Approximately six hundred homes were recruited to participate in the study by telephone contact thru random digit dialing. Passive dosimetry measurements included one-week sampling for nitrogen dioxide, air exchange rates, and absolute humidity. Measurements were taken in the kitchen, master bedroom and outside during the spring, summer and winter seasons.

19227 (DOE/ER/60493—1-Vol.1, pp 400-404) **Performance characteristics of Palmes diffusion tubes used for measurement of nitrogen dioxide outside residential sites.** Colome, S.D.; Lambert, W.E.; Castaneda, N.; Baker, P.E. (Univ. of California, Irvine). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

As part of a large scale indoor survey of nitrogen dioxide (NO_2) in the Los Angeles area, 120 residences were randomly selected from more than 400 homes participating during a winter sampling period. For the 102 homes agreeing to participate, one NO_2 diffusion tube was placed outside on the north side of the house and another was placed outside six feet above the ground. The latter sampler was placed on a pole away from building structures and vegetation, and covered by an opaque cup. A network of 19 chemiluminescence monitors was used to provide interpolated measures of outdoor NO_2 concentrations for each residence. Nitrogen dioxide interpolated from the chemiluminescence monitors was better correlated with NO_2 measured at the sampling poles than on the north face of the home ($r^2 = 0.65$ and 0.51, respectively). Implications for characterizing NO_2 outside residences are discussed.

19228 (DOE/ER/60493—1-Vol.1, pp 405-409) **Analysis of factors associated with indoor residential nitrogen dioxide: multivariate regression results.** Colome, S.D.; Wilson, A.L.; Becker, E.W.; Cunningham, S.J.; Baker, P.E. (Univ. of California, Irvine). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Approximately 600 homes in the Los Angeles Basin were selected as a probability sample of residences. Passive dosimeters were used to measure nitrogen dioxide inside and outside homes for three one-week periods, once during spring, summer, and winter. Air exchange was measured for a one-week average using a perfluorocarbon tracer; humidity was measured by molecular sieve. Housing information was collected by telephone from occupants, by technicians at the site, and from an activity log maintained by the occupants during sampling periods. Stepwise multiple regression was used to identify a set of variables that best predict indoor nitrogen dioxide measured in kitchens and bedrooms. Factors that explain variation in indoor nitrogen dioxide are classified into source, ventilation, or dilution terms that are predicted from theoretical mass balance models.

19229 (DOE/ER/60493—1-Vol.1, pp 410-414) **Temporal evaluation of nitrogen dioxide in thirty seven residences.** Colome, S.D.; Wilson, A.L.; Becker, E.W.; Cunningham, S.J.; Baker, P.E. (Univ. of California, Irvine). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Care is often taken to assure that homes sampled in indoor air quality surveys are representative of a larger population of residences. Frequently it is not possible, however, to determine whether the measurement time periods are representative of a sampling season. In this study thirty seven homes were monitored for one-week average nitrogen dioxide for a period of 17 to 25 weeks. Volunteers capped and uncapped diffusion tubes and recorded times for sampler changes. Every four weeks for the duration of the study diffusion tubes were returned for analysis and a new set of tubes mailed to the residents. Indoor NO_2 is associated with outdoor NO_2, but a wide range of explained variance exists among the individual homes in this study. Case histories demonstrate an association between elevated indoor concentrations of NO_2 and the onset of the heating season.

19230 (DOE/ER/60493—1-Vol.1, pp 415-419) **Variability in nitrogen dioxide readings within and between New York inner-city apartments.** Goldstein, I.F.; Andrews, H.; Bodian, C.; Kelley, G. (Columbia Univ. School of Public Health, NY). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Levels of NO_2 were measured during 9 seasons in 80 New York City apartments with gas cooking stoves, occupied primarily by lower income non-white families. In each apartment, consecutive readings of 48-hour average concentrations were taken at four different locations for one month. In the average season, 63% of the total variability in kitchen readings was due to differences between homes. There was a weak but statistically significant relationship between readings made in different homes on the same day. This shared day-related variability was not due to outdoor NO_2 levels; rather, it reflected similarities between homes in daily cooking patterns, ventilation and/or other indoor factors. Finally, there was a very strong relationship between NO_2 levels at different locations within the same home.

19231 (DOE/ER/60493—1-Vol.1, pp 420-424) **Estimation of nitrogen dioxide concentrations in homes equipped with unvented gas space heaters.** Hemphill, C.P.; Ryan, P.B.; Billick, I.H.; Nagda, N.L.; Koontz, M.D.; Fortmann, R.C. (Harvard School of Public Health, Boston, MA). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In this paper, a statistical and a physical model of indoor nitrogen dioxide concentrations are developed in parallel. The statistical model makes use of data collected in 82 homes using unvented gas space heaters (UVGSH) as the primary heat source. The physical model includes source terms appropriate for such heaters and loss terms indicative of convective and conductive heat loss. Results from the two models show good agreement. A stochastic model based on the physical model is then developed. This model is used to predict indoor nitrogen dioxide concentration distributions in homes using UVGSH as the primary heat source in other regions not measured.

19232 (DOE/ER/60493—1-Vol.1, pp 425-429) **Assessment and control of indoor air pollution resulting from wood-burning appliance use.** Kaarakka, P.; Kanarek, M.S.; Lawrence, J.R. (Univ. of Wisconsin, Madison). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A survey of indoor air combustion products has been done in 20 homes with wood burning appliances to identify potential factors which might be involved in the release of pollutants. Homes were selected to be without cigarette smokers, gas cooking stoves and kerosene space heaters. Each home was monitored twice with wood-burner operation and twice without. Participants recorded weight of wood burned, time of loading, damper settings and backdrafting episodes. Indoor levels of measured combustion products were quite low during both burn and non-burn periods. Respirable particulate and carbon monoxide levels were significantly higher in homes with stoves having visible leaks or backdrafting. Indoor NO_2 levels were significantly higher during wood-burning, however this increase was found to be due to higher outdoor levels and not direct indoor emissions.

19233 (DOE/ER/60493—1-Vol.1, pp 430-434) **Survey of factors affecting NO_2 concentrations.** Koontz, M.D.; Nagda, N.L. (GEOMET Technologies, Inc., Germantown, MD). 1987. NTIS, PC A. Order Number DE88C04513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

This paper describes the design, methodology, and preliminary results of a survey of homes with gas ranges that is being conducted in the Washington, DC, area. A multiphase monitoring program is used to gather both time-integrated and continuous measurements of contaminant concentrations and other relevant factors. The survey also includes varying extents of involvement for occupants versus trained field technicians in its different phases. Preliminary results indicate that occupants can follow instructions for placement and deployment of passive monitors, but have some difficulty in accurately estimating some important variables such as house volume.

19234 (DOE/ER/60493—1-Vol.1, pp 435-439) **Real-time concentration measurements of CO and NO_2 in twelve homes.** Lebret, E.; Noy, D.; Boley, J.; Brunekreef, B. (Agricultural Univ. Wageningen, Netherlands). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The study described in this paper was part of a larger investigation aimed at the characterization of carbon monoxide, nitrogen dioxide, respirable particles and volatile organic compounds levels in the Dutch housing stock. A detailed account of this larger study is given elsewhere. The purpose of the real-time measurements was to determine the transient concentration peaks of CO and NO_2 in relation to the use of unvented gas appliances.

19235 (DOE/ER/60493—1-Vol.1, pp 440-444) **Monitoring of inorganic air contaminants in indoor environments by direct reading diffusion tubes.** Pannwitz, K.H. (Draegerwerk AG, Luebeck, Germany, F.R.). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The atmosphere in the area of industrial plants is often monitored by means of the detector tube method. The developments of the last years have led to a detector tube system which requires no pump or other additional equipment to transport the hazardous compounds from the ambient atmosphere to the reagent layer inside the glass tube, because it works based on gaseous diffusion. These so-called direct reading diffusion tubes originally have been designed for measurements in the TLV-range over the period of a work-shift (8 hours). Research in our lab has shown that some types of the direct reading diffusion tubes can be exposed to the atmosphere for longer periods than 8 hours. Thus, the measuring range extends to smaller concentrations so that it becomes possible to determine hazardous substances in the air of housing spaces. As examples, carbon monoxide and carbon dioxide determinations using the direct reading diffusion tube method will be explained.

19236 (DOE/ER/60493—1-Vol.1, pp 445-450) **Portable monitor for the measurement of indoor NO_2 concentrations.** Stetter, J.R.; Chang, S.C. (Transducer Research Inc., Naperville, IL). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Electrochemical sensors have ideal logistical properties for portable field instruments because they are small, light-weight, and require little power. Personal monitors using amperometric sensors have been constructed and used successfully for field studies of carbon monoxide exposure at the ppm level (10^{-6} cc/cc air). However, NO_2 exposure at the ppb level (10^{-9} cc/cc air) may cause human health problems, and current sensors have too much drift to provide accurate problems, and current sensors have too much drift to provide accurate monitoring. In this work, a new design NO_2 personal monitor was tested and improvements were made to the amperometric sensors in four areas: pneumatic sampling system, electronics, optimization of the electrochemical reaction conditions, and instrument design.

19237 (DOE/ER/60493—1-Vol.1, pp 451-455) **Field study of nitrogen oxide levels inside and outside an international airport terminal.** Thurston, G.D. (New York Univ. Medical Center, Tuxedo, NY). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Air pollution levels were monitored inside and immediately surrounding the North Terminal at Newark's International Airport from mid-November through mid-December 1985. Nitrogen oxides (NO/sub x/) were sampled intermittently both inside and outside the concourse using Palmes tube diffusion samplers, while NO/sub x/ was also monitored continuously outside one gate. For one weekend, continuous outdoor NO and NO_2 concentrations were measured both at the height of the building ventilation inlets and at breathing level. Peak outdoor NO_2 levels were higher at breathing level, likely because of service vehicle NO/sub x/ emissions. Indoor NO/sub x/ levels were generally lower and less variable than outdoors. Both the indoor and outdoor levels tended to be highest where and when airport operations were the most active.

19238 (DOE/ER/60493—1-Vol.1, pp 456-460) **Comparison of passive and chemiluminescence monitors for determining one-week average nitrogen dioxide concentrations.** Wilson, A.L.; Colome, S.D.; Baker, P.E.; Cunningham, S.J.; Becker, E.W.; Bope, W.G. (Wilson Environmental Associates, Sierra Madre, CA). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Palmes diffusion tubes are frequently used in indoor air quality studies to measure integrated nitrogen dioxide concentrations. In this study the Palmes method is compared with integrated concentrations derived from continuous chemiluminescence instrumentation. Palmes tubes were located at 20 air monitoring sites in the Los Angeles Basin that are operated by the South Coast Air Quality Management District (SCAWMD). Pairs of Palmes tubes were exposed at most sites for a year. A total of 871 paired comparisons were possible. No pattern of bias was observed between the Palmes and chemiluminescence methods. Overall, the chemiluminescence instruments explained 83% of the variability in the NO_2 concentrations as measured by the Palmes tube with a regression slope of 0.9. Individual stations differ in their performance, three stations had correlation coefficients (R^2) below 0.6.

19239 (DOE/ER/60493—1-Vol.1, pp 468-472) **What effects does indoor air pollution due to domestic cooking have on chest problems of elderly women.** Jedrychowski, W.; Tobiasz-Adamczyk, B.; Mroz, E.; Gomola, K. (Institute of Social Medicine, Krakow, Poland). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

An attempt has been made to investigate the effects of indoor air pollution due to domestic cooking on the chest problems of the elderly women. The field study was carried out in the sample of 560 elderly women (above 65 yrs) living in the city center of Cracow. The health status of the respondents was assessed by MRC questionnaire as well as by spirometric examination. The results of the study showed that among persons dealing with gas cookers the prevalence of chest symptoms related clearly to the duration of exposure. The results of the paper draws special attention to the indoor health hazards for the elderly women involved in cooking the meals.

19240 (DOE/NBM—8003899) **National Acid Precipitation Assessment Program: Interim assessment: The causes and effects of acidic deposition: Volume 1, Executive summary.** (National Acid Precipitation Assessment Program, Washington, DC (USA). Office of the Director of Research). 1987. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88003899/JAW.

The Interim Assessment presents the state of the science in each Task Group subject area based largely on the NAPAP research but taking into account relevant research done elsewhere in the United States and abroad. The Interim Assessment focuses on the reduction in scientific uncertainties that have been accomplished by this research since 1982 and describes the effort toward further resolution of most of the major remaining uncertainties by 1990, the end of the program. Preliminary evaluation of possible economic impacts of acidic deposition has been attempted, but the lack of quantifiable effects constrains the assessment. An effort was made in 1985 to prepare an initial assessment, which was reworked in 1986 and 1987 into the Interim Assessment when it was realized that a large body of new scientific information was flowing in from NAPAP so that a more solidly based assessment could be made. 17 figs.

19241 (DOE/NBM—8003900) **National Acid Precipitation Assessment Program: Annual report 1986 to the President and Congress.** Herrick, C.N. (ed.). (National Acid Precipitation Assessment Program, Washington, DC (USA). Office of the Director of Research). 1986. 162p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88003900/JAW.

This statutory Annual Report to the President and Congress by the Interagency Task Force on Acid Precipitation marks the end of the fifth full year of an integrated research effort by the participating Federal agencies. The National Acid Precipitation Assessment Program is coordinated by the Task Force and focuses federally funded research on the timely development of a firm scientific basis for policy decisions that pertain to the phenomenon referred to as acid rain. The "Research Overview" section of the 1986 Annual report provides a synopsis of the results of past and present NAPAP research activities and an outline for future research efforts. This section is organized by task group and includes information on funding, expected deliverables, program highlights, and cooperative initiatives with groups outside the National Program. Task Group include Emissions and Controls, Atmospheric Chemistry, Atmospheric Transport, Atmospheric Deposition and Air Quality Monitoring, Terrestrial Effects, Aquatic Effects, and Effects on Materials and Cultural Resources. 450 refs., 27 figs., 34 tabs.

19242 (EPRI/EA—5468) **Urban power plant plume studies: Final report.** Murray, D.R.; Bowne, N.E. (TRC Environmental Consultants, Inc., East Hartford, CT (USA)). Jan 1988. 232p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920168/JAW.

The behavior of a buoyant plume emitted from a power plant stack located near the center of Indianapolis, Indiana was studied. Emitted sulfur dioxide was measured with a ground-based sensing device and particulate concentrations with an airborne sensing device. Additionally, sulfur hexafluoride (SF_6) gas was injected into the stack. Coincident ground level SF_6 concentrations were measured by an array of approximately 175 automated syringe samplers placed on eight to nine arcs downwind of the stack. Contemporaneous continuous measurements of wind velocities and temperature at up to four sites were augmented by frequent radiosonde measurements, humidity, incoming and net radiation, and atmospheric turbulence levels. Using these measurements, three versions of a gaussian model used for regulatory estimates of ground level concentration were evaluated. The findings demonstrated important shortcomings in all the models tested, including a general inability to estimate hour-by-hour ground-level concentrations. However, considering only the magnitudes of the maximum concentrations and their frequency distributions, the models bracketed the measured concentrations. That is, within the upper 80% of the cumulative frequency distribution, one version consistently predicted at or above while another version consistently predicted 15% to 30% below the measured concentration. As the concentration averaging time increased, the relative magnitude of the residuals decreased. This contrasts with studies of the rural models, for which the relative residuals increased with averaging time. 20 refs., 52 figs., 46 tabs.

19243 **(GSF-BPT—5/87) Ozone sonde and Dobson spectrometer data obtained during the MAP/GLOBUS 1983 campaign over Western Europe.** Attmannspacher, W.; Claude, H.; Hartmannsgruber, R.; Cisneros, J.; Bakker, C. de; Muer, D. de; Lovisa, A.; Marche, P.; Megie, G.; Munzert, K. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Bereich Projekttraegerschaften; Deutscher Wetterdienst, Hamburg (Germany, F.R.). Meteorologisches Observatorium; Wuppertal Univ. (Gesamthochschule) (Germany, F.R.); Institut Royal Meteorologique de Belgique, Brussels; Reims Univ., 51 (France); Centre National de la Recherche Scientifique, 91 - Verrieres-le-Buisson (France). Service d'Aeronomie). 1987. 275p. NTIS (US Sales Only), PC A12/MF A01. Order Number DE88751949/JAW.

During the international MAP/GLOBUS campaign in September 1983 in Southern France simultaneous ozone soundings and total ozone measurements were performed at some ozone stations in Western Europe.

19244 **(KFK-PEF—20) Source specific properties of air particulate material near the ground. A comparison of laser microprobe mass spectrometry (LMMS) and X-ray fluorescence analysis (XFA).** Wieser, P.; Schreiber, H.; Greiner, W. (comps.). (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre). Apr 1987. 178p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88751951/JAW.

In episodes before and during the TULLA-precampaign and during the TULLA-campaign air particulate materials were sampled exposing nuclepore filters and cascade miniimpactors (5 stages). Considering the geographical and industrial structure of Baden-Wuerttemberg 6 locations on the ground and 8 (TULLA-precampaign) respectively 24 (TULLA-campaign) flight pattern positions (aircrafts) were chosen for particle sampling. XFA of the filter specimen is used to get the elemental concentrations. The LMMS of single air particulate materials results in sets of mass spectra both of positive and negative ions suitable for separation of source specific particle components by using discriminant analysis, where air particulate materials originating from different air parcels are classified into different groups. E.g. the signals of marker elements such as Al, V, Mn, Fe and Ni are used to compute the canonical variables. Also a cluster analysis seems to be useful. Further information obtained are the giant particle number concentration, the sulfur content the latter given by electron probe microanalysis (EPMA) of air particulate material deposited on the last two impactor stages and estimated gradients of these values, respectively. The molar ratio of SO/sub 2/- and SO/sub 4/-concentrations are calculated using SO/sub 2/-values stored in the TULLA data bank. With 47 figs., 45 refs., 27 tabs..

19245 **(KFK-PEF—22) Pilot study 'Emission inventory for volatile organic compounds'.** Friedrich, R.; Obermeier, A.; Voss, A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftre; Stuttgart Univ. (Germany, F.R.). Inst. fuer Kernenergetik und Energiesysteme). Mar 1987. 80p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751952/JAW.

Volatile organic compounds play a significant part in the discussion about air pollution control. Further investigations of these harmful substances in air chemistry models require data about the temporal and spatial allocation of the emissions. Therefore methods for the calculation of daily emissions of volatile organic compounds in each community of Baden-Wuerttemberg are investigated in this study. In a first step a list is drawn up which contains important volatile organic compounds to be reported separately by this inventory. Emission factors and composition data are compiled for major source categories. The overall emissions of volatile organic compounds in Baden-Wuerttemberg are roughly estimated. Methods to be applied for calculation of emissions of volatile organic compounds in a high spatial, temporal and species resolution are developed. With 11 figs., 48 refs..

19246 **(LBL—23687) Analysis of carbon particle deposition on Teflon filters using Fourier transform infrared spectroscopy.** Pollard, M.; Jaklevic, J.; Howes, J. (Lawrence Berkeley Lab., CA (USA); Environmental Monitoring and Services, Inc., Camarillo, CA (USA)). Oct 1987. Contract AC03-76SF00098. 24p. (CONF-871055—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005449/JAW.

From 3. international conference on carbonaceous particles in the atmosphere; Berkeley, CA, USA (5 Oct 1987).

Fourier transform infrared absorption measurements of particulate elemental carbon are compared with results obtained using a thermal combustion method of analysis. Ambient air samples were collected on Teflon and quartz filters on each day during the sampling study. The quartz filters were analyzed for elemental and organic carbon using a thermal combustion method of analysis. The Teflon filters were analyzed for elemental carbon by infrared transmission in the region 650 - 666 cm^{-1}. Good correlation was found between the infrared absorbance on the Teflon filters and the elemental carbon determined from analysis of the quartz filters. Calibration methods for the infrared technique are discussed.

19247 **(LBL—24556) The interaction of nitrogen dioxide with carbon and alumina particles.** Gundel, L.A.; Guyot-Sionnest, N.S.; Novakov, T. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 19p. (CONF-870853—5). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005738/JAW.

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Laboratory studies have shown that NO_2 gas adsorbed without reaction on alumina particles. At $[NO_2] = 4$ ppM in air, 11-12% of the NO_2 was removed from the gas stream. The trapped gas appeared as equal amounts of NO_2^- and NO_3^- in water extracts of the particles. NO_2 reacted with activated carbon particles, forming NO, NO_2^-, and NO_3^-. The major product was NO_3^-. Carbon removed 95-96% of the NO_2 entering at 4 ppM in air. At this concentration of NO_2, the presence of water vapor in the air stream did not have much effect on the ability of either of these types of particles to interact with the gas. At $[NO_2] = 20$ ppM, alumina displayed the same behavior as at the lower gas concentration, except that its trapping capacity decreased in the presence of humid air. At the higher NO_2 concentration, carbon particles showed dramatically different product distributions, depending on the presence of water vapor. In dry air NO dominated, followed by NO_3^-. In humid air about equal concentration of NO and NO_2^- were formed. These results are consistent with surface oxidation of carbon particles and formation of surface nitrate. In the presence of water vapor, nitrous acid was formed from the interaction of NO and the surface nitrate. 12 refs., 3 figs., 2 tabs.

19248 **(PB—88-125984/XAB) Health-hazard evaluation report HETA 87-013-1803, West Seattle Community Hospital, Seattle, Washington.** Gunter, B.J.; Daniels, W.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1987. 21p. (HETA—87-013-1803). NTIS, PC A03/MF A01.

An evaluation was made in the operating rooms (ORs); the recovery room, and in the OR reception area for nitrous oxide, ethrane, halothane, and isoflurane. Measurements were also taken for ethylene oxide (EtO). Of 15 samples taken and tested for NO_2, five exceeding the NIOSH Recommended Exposure Limit of 25 parts per million (ppm). Isoflurane was found in all 12 personal and area air samples at concentrations from 0.09 to 1.96 ppm. Ethrane was present in three of 12 samples at concentrations from 0.36 to 0.96ppm. Halothane was below the limit of detection. Isoflurane was detected in a personal sample from the recovery room and in the area sample from the OR reception area at concentrations of 0.69 and 0.65ppm, respectively. EtO levels ranged from 0.02 to 0.11ppm. The authors conclude that a hazard did exist specifically in relation to overexposures to N_2O, ethrane, and isoflurane.

19249 **(PB—88-126099/XAB) Industrial-hygiene walk-through survey report of Loctite Corporation, Newington, Connecticut.** McCammon, C.S.; Krishnan, E.R.; Goodman, R.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 17 Jul 1987. 17p. (IWS—157.23). NTIS, PC A03/MF A01.

A walk-through industrial-hygiene survey was conducted at the Loctite Corporation facility located in Newington, Connecticut in order to evaluate possible employee exposure to acrylates or methacrylates used at the facility. Methacrylate-based anaerobic-curing adhesives have been formulated at the facility since 1968. Difunctional methacrylates were most often used and were, in most cases, purchased from outside companies. There was some on-site manufacturing of methacrylate monomers in enclosed vessels with local exhaust ventilation at the point sources. Enclosed vessels were also used to formulate the intermediate high-viscosity oligomers and the adhesive products. Of the 70 employees at the facility, 47 had potential exposure to methacrylates during manufacturing operations. No air monitoring had been conducted at the company. A few cases of dermatitis have occurred due to exposure to methacrylates. A safety program was in place at the firm and there were records for all employees.

19250 **(PB—88-126107/XAB) Industrial hygiene walk-through survey report of General Motors Corporation, Fisher Guide Division, Monroe, Louisiana.** McCammon, C.S.; Krishnan, E.R.; Goodman, R.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 17 Aug 1987. 19p. (IWS—157.24). NTIS, PC A03/MF A01.

A walk-through industrial-hygiene survey was conducted at the General Motors Corporation Fisher Guide manufacturing facility located in Monroe, Louisiana. The investigation centered on possible exposure to acrylates or methacrylates during the manufacture of adhesive-sealed, flame-sealed, or composite headlamps. Methacrylate-based adhesives and acrylated coatings have been used at the facility since 1981. Both the adhesives and coatings were cured by ultraviolet radiation. Ninety-four employees had potential contact with acrylates or methacrylates during the application of adhesives and coatings. Adhesives were used for sealing the lens/reflector area and the bulb location of the terminal area. Base coats were applied to the composite headlamps to provide an adhering surface for the aluminized coating. Top coats were applied as a protective coating for the aluminum coating. Two cases of chemical dermatitis have been reported at the facility since 1981 due to skin contact with acrylates/methacrylates. When an automated system was used to apply adhesive materials during headlamp assembly, there was a lower potential for employee exposure to the hazardous chemicals. The authors recommend that the company move toward complete automation of this part of the production process. Levels of butyl-acetate should be checked as there was a strong smell of this chemical in part of the production line.

19251 **(PB—88-126149/XAB) Health-hazard evaluation report HETA 84-289-1798, Kirby Manufacturing Company, Inc., McClure, Pennsylvania.** Crandall, M.S.; Singal, M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). May 1987. 19p. (HETA—84-289-1798). NTIS, PC A03/MF A01.

In response to a request from an employer representative, an evaluation was made of the Kirby Manufacturing Company located in McClure, Pennsylvania concerning possible exposure to formaldehyde from the resin used to give a wrinkle-resistant property to textiles. Full-shift breathing-zone and general-air-monitoring samplings were performed. In 14 samples the personal exposure to formaldehyde ranged from 0.5 to 1.5 parts per million (ppm) with an average of 1.0 ppm. A questionnaire regarding symptoms was completed by 100 workers. Symptoms reported to be occurring more frequently of late included sneezing, nasal irritation, headache, eye irritation, throat irritation, and coughing. As these symptoms were connected with formaldehyde exposures, the authors conclude that overexposure to formaldehyde was occurring at the facility. The authors recommend that a specialist in industrial ventilation systems be consulted to prepare specifications for a dilution ventilation system for the facility. Using the new system, indoor air containing formaldehyde vapor would not be recirculated. Fabrics containing formaldehyde should be aired before further treatment or use.

19252 **(PB—88-126156/XAB) Health-hazard evaluation report HETA 86-372-1796, National Marine Fisheries Service, US Department of Commerce, Pascagoula, Mississippi.** Boiano, J.M.; Cantor, F.L.; Burr, G.A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). May 1987. 30p. (HETA—86-372-1796). NTIS, PC A03/MF A01.

In response to a request from the U.S. Department of Commerce, an evaluation was made of an ongoing mold and mildew problem at the Southeastern Regional Office of the National Marine Fisheries Service located in Pascagoula, Mississippi. Office workers indicated they were suffering from throat irritation, itchy eyes, sneezing, and coughing symptoms. The problem was traced to an improperly installed all-water heating, ventilating, and air-conditioning system. Deficiencies in the system resulted in water damage, high humidity, and the growth of mold and mildew on all surfaces. Dehumidifiers were useful in reducing the humidity level, and therefore the growth of mildew and mold, but there was still some visible contamination on room surfaces. Airborne levels of total viable microorganisms averaged 1,236 colony-forming units per cubic meter of air. The most-abundant fungal species isolated was Acremonium species. When the results of a medical questionnaire were compared to levels of fungal contamination there was no statistically significant association between the occurrence of illness and exposure to microorganisms. The authors recommend that insulation on the pipes and condenser drain lines be replaced to eliminate the moisture-incursion problems, that all nonporous surfaces be disinfected, and that all nondisposable building contents be cleaned with a vacuum incorporating a high-efficiency particulate air filter. Materials which could not be adequately cleaned were to be discarded.

19253 **(PB—88-126453/XAB) Health-hazard evaluation report HETA 86-438-1795, HETA 86-534-1795, Bondar-Clegg, Lakewood, Colorado, Sparks, Nevada.** Gunter, B.J.; Richardson, F.; Anderson, K.E. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). May 1987. 14p. (HETA—86-438-1795). NTIS, PC A03/MF A01.

In response to requests from management of Bondar-Clegg located in Lakewood, Colorado and Sparks, Nevada, evaluations were made of exposure to lead in two fire-assay laboratories. Breathing zone and general room air concentrations of lead were measured at each facility. All eight samples taken at Lakewood exceeded the evaluation criteria of 0.05mg/cu m with the range being from 0.1 to 0.6mg/cu m. Of 14 samples taken at Sparks, nine exceeded the criteria, ranging from 0.01 to 0.49mg/cu m. Improvements were needed in the exhaust ventilation systems at each location. Medical evaluations of ten employees at Sparks showed blood lead levels within the OSHA regulatory limits. However, three workers were over 40 micrograms/deciliter, the limit for returning to a job that involves lead exposure. The authors conclude that a health hazard existed from overexposure to lead at these facilities. The authors recommend improvements in the ventilation system and an upgraded respirator program. All workers should be advised of the toxic properties of lead exposure. Workers in the assay department should shower and change clothes and shoes at the end of the day to prevent lead contamination from entering the home. Personal hygiene should be improved. Medical monitoring of workers should continue.

19254 **(PB—88-126636/XAB) Health-hazard evaluation report HETA 83-458-1800, Tropicana Products, Bradenton, Florida.** Salisburg, S.A.; Bennett, D.E. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). May 1987. 29p. (HETA—83-458-1800). NTIS, PC A03/MF A01.

In response to requests from Tropicana Products, Inc., Bradenton, Florida and the International Brotherhood of Teamsters, Washington, D.C., an evaluation was made of possible exposure to ultraviolet-cured printing inks during citrus-juice bottling. A group of 71 workers from the area of the facility where the operation occurred were interviewed by a medical officer. A group of 43 workers from another area were interviewed and served as comparisons. Concentrations of airborne organic vapors released from the wash solvents and printing ink were determined. Patch tests were con-

ducted using components of the ink on workers from each group. Vapors of the following solvents were detected at levels below those considered hazardous: toluene, xylene, acetone, isopropanol, a series of alkanes, and 2-butoxyethanol. An overexposure was determined to exist for third shift workers involved in cleaning the printing machines using UVW80 wash solvent. Exposure levels for the shift to alkyl substituted benzenes exceeded 25 parts per million. The only ink component to give a positive patch test as a skin sensitizer among two workers was trimethylol-propane-triacrylate. The authors recommend that an ink wash solvent be found for use which contained a lower percentage of aromatic hydrocarbons. If this is not possible, then improvements to the ventilation system are needed and respiratory equipment should be worn.

19255 **(PB—88-127246/XAB) Industrial-hygiene walk-through survey report of Tetra Pak, Inc., Denton, Texas.** McCammon, C.S.; Krishnan, E.R.; Goodman, R.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 5 Jun 1987. 19p. (IWS—157.18). NTIS, PC A03/MF A01.

A walk-through industrial-hygiene survey was conducted at the Tetra Pak Denton facility in Denton, Texas to determine possible employee exposure to acrylates or methacrylates. Acrylated inks and coatings have been used at this facility since 1984 to produce aseptic flexible packaging material for the food industry. There were three offset printing press lines used at the company, each with five offset presses to apply different colored inks. As many as five separate wet-on-wet applications of acrylated ink formulations sometimes preceded the coating application. After the inks were applied they were passed through an offset blanket coater. Following this step an electron-beam-curing unit radiated the inks and coating. Environmental enclosures surrounded the offset-printing presses in order to cut down on noise and mist. Of the 176 employees at this company, 37 had potential contact with acrylates. No air monitoring has been conducted at this facility for acrylates. One case of dermatitis arose at the company since 1984 and possibly was related directly to skin contact with acrylates. There was a safety program in place at the company and personnel records were maintained for each employee.

19256 **(PB—88-128350/XAB) Health-hazard evaluation report HETA 84-284-1701b (revised), Granite City Steel, Granite City, Illinois.** Almaguer, D.; Orris, P. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). May 1987. 25p. (HETA—84-284-1701B). NTIS, PC A03/MF A01.

See also PB—87-105581.

In response to a request from the International Chemical Workers Union, an evaluation of possible exposures to a tar-like substance was made at Granite City Steel Company, Granite City, Illinois. This substance, a coal-tar-sludge residue, was added to coal coming into the facility. Samples of the coal-tar sludge and mixtures of the sludge and coal were taken from the tar pit and from the area inside the pulverizer building. Chemicals identified in these samples included: naphthalene, phenanthrene, fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(e)pyrene, benzo(a)pyrene, and benz(g,h,i)perylene. Of eight personal air samples taken, five had detectable concentrations of benzene solubles which ranged from 88 to 141 micrograms/cubic meter (microg/m^3). Some polynuclear aromatic hydrocarbon exposures were recorded at 20 to 100microg/m^3. The authors conclude that a health hazard existed in the coal-handling area and the by/products department.

19257 **(PB—88-128400/XAB) Health-hazard evaluation report HETA 86-486-1799, New Jersey Education Association, Trenton, New Jersey.** Mehta, M.; Jenkins, J.; Liveright, T. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). May 1987. 21p. (HETA—86-486-1799). NTIS, PC A03/MF A01.

An evaluation was made of the NJEA building in Trenton, New Jersey due to reports of headache, sore throat, and eye irritation among employees. Air monitoring tests were conducted for formaldehyde, carbon dioxide, carbon monoxide, dry bulb temperature, wet bulb temperature, humidity, and air velocity at air inlet and exhaust diffusers. Very little to no air movement was detected at employee work locations. Inside the building, the carbon-dioxide concentrations were two to four times those outside the building. Controls used to operate dampers and supply outdoor air in some cases appeared faulty and needed inspection and adjustment. Relative humidity was lower than recommended. No detectable levels of formaldehyde or carbon monoxide were found. Eighty percent of the employees returned completed questionnaires concerning symptoms of health problems. Repeated complaints of dryness of mucous membranes, dryness of eyes, headache, and tiredness were noted.

19258 **(PB—88-128749/XAB) Study of the efficacy of aerosol versus nonaerosol laundry products. Final report.** Boggs, R.R.; Belmont, B. (American Research and Testing, Inc., Gardena, CA). Oct 1987. 117p. NTIS, PC A06/MF A01.

The California Air Resources Board estimates that 6.6 tons of photochemically reactive organic compounds (PROC) are released into the environment in California every day because of the use of aerosol laundry products. The project studied the efficacy, ease of product use, and PROC content for three major brands of pre-wash stain removers in available product forms and for five starch products in their available product forms. Efficacy of pre-wash products was generally found to be limited. They were particularly useful for oil and ball point ink removal. Aerosols were found to be slightly superior. PROC content varied from 16-76% on aerosols; none was found in nonaerosols. Aerosols were found to be slightly easier to use by the laboratory investigator. For starches, on synthetic fabrics Faultless aerosol was found to be superior. For natural fabrics, results were mixed. Efficacy per unit cost was found to be high for bulk starches. PROC content for the two aerosols was 5.8% for Faultless and 8.5% for Niagra. Aerosols were easiest to use and bulk products rather difficult to use.

19259 **(PB—88-128939/XAB) Industrial-hygiene characterization of ethylene oxide exposures of hospital and nursing-home workers.** Ringenburg, V.L.; Elliott, L.J.; Morelli-Schroth, P.; Molina, D. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA). Div. of Surveillance, Hazard Evaluation and Field Studies). Dec 1986. 102p. (IWS—152.22). NTIS, PC A06/MF A01.

Industrial-hygiene surveys were conducted at 12 hospitals and one nursing home to determine possible employee exposure to ethylene oxide (EtO). Different types of exposure situations existed at each of the facilities as a result of various engineering controls, administrative controls and work practices. Sampling indicated that the time-weighted averages (TWAs) of exposure over periods of 36 to 724 minutes ranged from below the limit of detection to 6.7 parts per million (ppm). Personal short-term exposure levels covering 2 to 30 minutes ranged from less than the limit of detection to 103.2ppm. Factors found to be responsible for these higher-than-permissible levels of EtO exposure included improper installation or lack of engineering controls (such as improper placement of the sterilizing operations), unbalanced ventilation systems, and lack of administrative controls resulting in inappropriate work practices.

19260 **(PB—88-130059/XAB) Review of UCR (University of California-Riverside) protocol for determination of OH (hydroxyl radicals) rate constants with VOC (volatile organic chemicals) and its applicability to predict photochemical ozone production.** Bufalini, J.J.; Arnts, R.R. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Nov 1987. 33p. (EPA—600/3-87/046). NTIS, PC A03/MF A01.

The experimental protocol for determining the rate constants for reactions of hydroxyl radicals (OH) with volatile organic chemicals (VOCs) as developed by the University of California-Riverside group is evaluated. Limits of detection and precision are discussed. The protocol is to be used as a measure of the ozone-forming potential of a VOC; a compound with a high OH rate constant also very often produces high levels of ozone. Adaptations of the protocol for compounds containing halogen atoms are suggested. The protocol may not be applicable for compounds that do not produce RO_2 and HO_2 radicals such as carbon disulfide. Also, compounds that are free-radical scavengers such as phenol, benzaldehyde, and amines may not give high levels of ozone even though

they may have a high rate of reaction with OH radicals. The long chained paraffins also present problems with the protocol since the RO_2 radicals produced after reacting with OH radicals in air do not oxidize NO to NO_2 but instead combine with the NO to form nitrates. When this occurs, it is recommended that the protocol be complemented with smog-chamber experiments in order to establish the reactivities of VOCs.

19261 **(PB—88-130067/XAB) Nonmethane organic-carbon concentrations in air masses advected into urban areas in the United States. Final report.** Westberg, H.; MacGregor, L. (Washington State Univ., Pullman (USA)). Nov 1987. 309p. NTIS, PC A14/MF A01.

This report describes recent aircraft sampling programs to measure nonmethane organic carbon (NMOC) levels aloft in the upwind vicinity of several U.S. cities during the morning period of 0600 - 0900 A.M. The cities studied included Dallas-Ft. Worth, Tulsa, Atlanta, Birmingham, Philadelphia, and New York City. Individual hydrocarbon compounds were measured using gas-chromatographic procedures. The organic carbonyl compounds were collected on silica-packed SEP-PAK cartridges impregnated with 2,4-dinitro phenyl hydrazine (DNPH) and analyzed by HPLC. The data collected will be used in photochemical ozone models, such as OZIPP, to determine ozone control strategies.

19262 **(PB—88-130133/XAB) Tropospheric ultraviolet radiation: assessment of existing data and effect on ozone formation. Final report, March 1986-July 1987.** Gery, M.W.; Edmond, R.D.; Whitten, G.Z. (Systems Applications, Inc., San Rafael, CA (USA)). Nov 1987. 202p. NTIS, PC A10/MF A01.

The study to determine the impacts of future changes in stratospheric ozone and surface temperature on urban air quality was carried out in two parts. The first part assesses the quality of existing ultraviolet data and approaches available for using these data to determine chemical photolysis rates. The second part involves testing the photochemical model for a number of urban data sets under conditions of decreased stratospheric ozone and increased surface temperature. The results of the study indicate an increase in ambient ozone, H_2O_2, and PAN concentration occur for most cities with decreasing ozone column. An increase in ambient temperature results in most cases with an increase in oxidants. PAN, however, which is temperature sensitive exhibits in many cases a decrease with increasing ambient temperature.

19263 **(PB—88-130240/XAB) Developments in National Weather Service meteorological data-collection programs as related to EPA (Environmental Protection Agency) air pollution models. Report for May 1986-October 1987.** Pierce, T.E.; Turner, D.B. (Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab.). Nov 1987. 121p. (EPA/600/3—87/048). NTIS, PC A06/MF A01.

During the next decade, the National Weather Service (NWS) will be upgrading its meteorological instrumentation and data-dissemination procedures. Because these changes will affect the operation of the U.S. Environmental Protection Agency's (EPA) air-pollution models, the project has been undertaken to report on proposed changes and to recommend how to make optimal use of the new NWS data products. New instrumentation will include automated surface observation systems, next generation radar, and remote profilers. Data dissemination is being upgraded with an automated weather-interactive-processing system.

19264 **(PB—88-130281/XAB) Roles of models in the forest response program.** Kiester, A.R. (Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.). Nov 1987. 12p. (EPA—600/D-87/334). NTIS, PC A03/MF A01.

The Forest Response Program is a US Environmental Protection Agency and USDA Forest Service interagency research program on the effects of acidic deposition (acid rain) on trees and forests. The program plans to use a diversity of models to accomplish several goals. Two primary goals are to understand the effects of sulfur and nitrogen deposition on trees and forests and to be able to predict the response of trees and forest to alternative deposition scenarios.

19265 **(PB—88-130950/XAB) Health-hazard evaluation report HETA 85-414-1805, New Mexico State Highway Department General Office Building, Santa Fe, New Mexico.** Kominsky, J.R.; Melius, J.M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1987. 149p. (HETA—85-414-1805). NTIS, PC A07/MF A01.

Work associated with the decontamination, certification and reoccupancy of the Annex Building and the General Office Building of the New Mexico State Highway Department was reported. These efforts were undertaken following an electrical malfunction in a transformer which caused the askarel cooling fluid in the transformer to vaporize, venting polychlorinated-biphenyls (PCBs), polychlorinated dibenzofurans (PCDF) and polychlorinated-dibenzo-p-dioxin (PCDD) from the pressure-relief device on the transformer. Convective air currents and mechanical transfer through the heating, ventilating, and air-conditioning systems carried the contaminants throughout the building. The maximum air concentration levels detected following the decontamination of the buildings were 0.18 micrograms/cubic meter for PCB in air and 1.5 picograms/cubic meter for PCDF/PCDD in air. Surface samples were 34 micrograms/square meter and 0.42 nanograms/square meter, respectively. These were below the guideline levels. The authors conclude that the buildings are acceptable for occupancy and the contents are safe for use. The authors recommend that the buildings should be retested approximately 12 months after reoccupancy to determine that conditions have not changed.

19266 **(PB—88-131610/XAB) Dry acid deposition: monitoring technique for nitric acid and particulate nitrate - size distributions of acidic particles. Final report.** John, W.; Wall, S.M.; Ondo, J.L. (California Dept. of Health Services, Berkeley (USA). Air and Industrial Hygiene Lab.). Oct 1987. 89p. (CA/DOH/AIHL/SP—46). NTIS, PC A05/MF A01.

This research project involved three related efforts: (1) field and laboratory evaluation of the dichotomous sampler to measure nitric acid and particulate nitrate; (2) measurement of aerosol size distribution for nitrate and major ionic species using the Berner impactor; (3) direct measurement of dry-deposition fluxes of particles on natural and surrogate surfaces. Two parallel sampling trains, one consisting of a dichotomous sampler with a modified filter holder, and the other consisting of an AIHL cyclone and filter pack, sampled nitric acid and particulate nitrate (both fine and coarse fraction). Under a wide range of laboratory and field conditions, it was found that the dichotomous sampler quantitatively denudes nitric acid and, therefore, provides a method for the sampling of particulate nitrate that is free of positive artifacts from nitric acid. The Berner Cascade impactor was used to test the techniques needed to measure the size distribution of inorganic ions. Detailed evidence was obtained for the production of coarse nitrate and hydrochloric acid by the reaction of nitric acid with sea salt aerosol.

19267 **(PB—88-143987/XAB) Influence of sorbent physical properties upon reactivity with sulfur dioxide. Final report, Januar 1985-September 1986.** Cole, J.A.; Kramlich, J.C.; Seeker, W.R.; Silcox, G.D. (PEI Associates, Inc., Cincinnati, OH (USA)). Dec 1987. 119p. NTIS, PC A06/MF A01.

This report gives results of sulfation behavior measured at 1000 and 1200 C for eight calcium oxide sorbents which were well characterized in terms of particle size, pore structure, and specific surface area. Sulfation results were compared with predictions of a simple mathematical model which applied the measured sorbent characteristics. The comparison, intended to provide direction for model development, suggests need for model improvement in areas such as global kinetics at short times, and accountability for changes in structure due to sintering during sulfation. Subsequently, the effects of high temperatures on surface areas of the sorbents in the absence of sulfation were also determined. Surface areas were marginally higher for the larger sorbents at 1000 C injection; but, in general, no correlation between particle size and surface area loss could be found. Surface-area decay was shown to be very rapid in the first 200 ms, and subsequently very slow.

19268 **(PB—88-144001/XAB) Fundamental combustion research applied to pollution formation. Volume 4. Engineering analysis. Final report, January 1977-September 1980.** Kau, C.J.; Heap, M.P.; Seeker, W.R.; Tyson, T.J. (Energy and Environmental Research Corp., Irvine, CA (USA)). Dec 1987. 211p. NTIS, PC A10/MF A01.

See also Volume 1, PB—86-122660.

This report is the fourth and final volume in a series documenting research activities under the EPA's Fundamental Combustion Research (FCR) program applied to pollution formation. The FCR program had three major objectives: (1) to generate an understanding of combustion behavior necessary to help develop control strategies to minimize NOx emissions from stationary sources; (2) to develop engineering models that would allow effective utilization of a large body of fundamental information in the development of new NOx control techniques; and, (3) to identify critical information necessary for low-NOx combustor development and to generate it in a time frame consistent with the needs of EPA's technology development programs.

19269 **(PNL-SA—14770) Spatial estimation of annual wet acid deposition using supplemental precipitation data.** Wampler, S.J.; Olsen, A.R. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. Contract AC06-76RL01830. 6p. (CONF-8710243—1). NTIS, PC A02. Order Number DE88003414/JAW.

From 10. conference on probability and statistics in atmospheric science; Alberta, Canada (6 Oct 1987).

The current study investigates two alternative approaches to the estimation of sulfate deposition. In the first approach, data from wet deposition monitoring sites from the Acid Deposition System (ADS) data base are used to estimate deposition. In the second approach, wet deposition monitoring sites from ADS are used to estimate concentration, but the more extensive network of precipitation monitoring sites available from the National Climatic Data Center is used to estimate precipitation amount to the watersheds and deposition is calculated as the product of the two estimates. In both cases kriging is used to do the spatial interpolation from monitoring sites to the watersheds. 9 refs., 7 figs.

19270 **(RFP—4086) Overview of the Terrain-Responsive Atmospheric Code (TRAC).** Hodgin, C.R. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 19 Dec 1986. Contract AC04-76DP03533. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005465/JAW.

The Rocky Flats Plant is developing a series of dispersion/dose codes that will realistically simulate complex atmospheric conditions. This report provides an overview of the atmospheric dispersion model development program now underway at the Rocky Flats Plant.

19271 **(UCID—21202) The evaluation of four models of personal air samplers.** Boyer, J.F.; Held, B.J. (Lawrence Livermore National Lab., CA (USA)). 1988. Contract W-7405-ENG-48. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005563/JAW.

Four makes of personal air samplers were selected and purchased for test and evaluation to help determine which kind or kinds would best serve the needs of our field industrial hygienists and health and safety technicians. The physical characteristics and special features of each sampler were compared, and laboratory tests were conducted to determine how long the pumps would operate without recharging or undergoing a change in flow rates and noise levels. There are no conclusions in this report, since it is intended to be a guide to field personnel for selecting a sampler that will best suit their needs for a particular operation. 5 tabs.

19272 **(UCID—21287) Pollutant transport study: Bay Area to North Central Coast air basin: Final report.** Penner, J.E.; Connell, P.S. (Lawrence Livermore National Lab., CA (USA)). May 1987. Contract W-7405-ENG-48. 222p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88004731/JAW.

A multi-layer photochemical transport model has been developed and applied to study the transport of pollutants from the Bay Area to the North Central Coast air basin. To study this issue required the development of a model capable of treating a several-day smog episode so that transport times sufficient to describe inter-basin transport episodes could be described. The model was applied to simulate the ozone episode of September 30 and October 1, 1980. For this work, a two basin emissions inventory for 1980 was prepared. In addition, meteorology fields for the two-basin model domain were prepared. An updated version of the MATHEW model was developed which allows the user to specify the mixed-layer depth and restricts flow across that layer. The effect of Bay Area hydrocarbon and nitrogen oxide emission controls were tested by separately reducing their emissions by 30% in the Bay Area. We found that reducing hydrocarbons in the Bay Area had a slight, but beneficial effect on the MBUAPCD. Ozone concentrations were reduced in both air basins. Also, as expected, reducing nitrogen oxide emissions led to increased ozone concentrations in the Bay Area. Surprizingly, however, the effect of NO/sub x/ emissions was reversed at MBUAPCD receptor sites. There is a narrow downwind band in which ozone concentrations are decreased by about 1 pphm when NO/sub x/ emissions are decreased. However, because the calculated effect is so small, it is also quite uncertain. Both meteorology changes and chemical mechanism changes could alter the result. 66 refs., 200 figs., 26 tabs.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 18253, 19108, 19270, 19608, 19618

19273 **(ORNL/M—389) Environmental surveillance data report for the third quarter of 1987.** Daniels, K.L.; Goldberg, P.Y.; Horwedel, B.M.; McCollough, I.L.; Osborne-Lee, A.E.; Owenby, R.K.; Watson, J.B.; Wilson, M.M. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 95p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88004269/JAW.

During the third quarter of 1987, over 1600 samples which represent more than 5000 analyses and measurements were collected by the Environmental Monitoring and Compliance (EMC) Department. Uranium concentrations measured on air filters near the Y-12 plant were higher than normal due to a release from that facility in May. More than 60% of the noncompliances with the NPDES permit for the third quarter occurred in July. These were primarily in total suspended solids at the Sewage Treatment Plant. The cause of these high concentrations has been explored with the plant operating staff but is currently unresolved. Because of past noncompliances in fecal coliform and chlorine concentrations at the Sewage Treatment Plant, an engineering review has been initiated to examine the present chlorination system. This review is intended to provide a permanent solution to these types of problems. Maximum concentrations of total radioactive strontium ($^{89}Sr + {}^{90}Sr$) in bluegill were lower than those measured during the second quarter. There were not significant differences in the total radioactive strontium in blue gill at any of the Clinch River locations. 17 figs., 45 tabs.

19274 **(PB—88-128335/XAB) NIOSH (National Institute for Occupational Safety and Health) testimony to Department of Labor on the Mine Safety and Health Administration proposed rule: ionizing radiation standards for metal and nonmetal mines, August 13, 1987 by R. Niemeier.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 13 Aug 1987. 22p. NTIS, PC A03/MF A01.

Recommendations were offered for protecting workers against the health effects of ionizing radiation in metal and nonmetal mines. Available data demonstrating such health effects was reviewed and evidence supporting the technical feasibility of reducing the current Mine Safety and Health Administration (MSHA) standard was presented. Five recent studies indicated a significant increase in lung cancer rates associated with radon progeny exposure in underground mines. Additional studies indicated an exposure/response relationship in uranium miners. The influence of smoking on the association between radon progeny exposure and lung cancer was cited. Evidence has indicated that exposure to radon progeny carries a potential risk of developing occupationally induced lung cancer. Risk-assessment data supported the conclusion

that miners with the same characteristics as the United States Public Health Service uranium miners cohort and who accrue a cumulative occupational exposure of 120 working level months, would have a lung cancer excess lifetime risk of about 35 to 40 lung cancer deaths per 1000 exposed miners. Modern mining methods using dilution ventilation as well as bulkheading and backfilling techniques make it possible to achieve substantial reductions in the cumulative exposure to radon progeny. Information was provided on sampling strategy, control technology, ventilation systems, respirators, and medical surveillance programs.

19275 **(PB—88-156617/XAB) Installation and testing of indoor radon reduction techniques in 40 eastern Pennsylvania houses. Final report, October 1984-June 1987.** Scott, A.G.; Robertson, A.; Findlay, W.O. (American ATCON, Inc., Wilmington, DE). Jan 1988. 399p. (EPA—600/8-88/002). NTIS, PC A17/MF A01.

This report discusses the installation and testing of indoor radon-reduction techniques in 40 houses in eastern Pennsylvania. Early in 1985, the Pennsylvania Department of Environmental Resources (PDER) started a large radon survey in communities in the Reading Prong (a granite formation) in eastern Pennsylvania, following the discovery of a house with extremely high radon concentrations, greater than 1.2 MBq/cu m. Candidate houses for the program, with radon concentrations in excess of 750 Bq/cu m, were selected from this survey. A total of 40 houses with representative substructure types were chosen from this group, and mitigation methods were selected and installed from June 1985 to June 1987. Initial soil-ventilation installations achieved large reductions in radon concentrations at low cost, but these reductions were not always sustained in colder weather, and several systems were modified during the project to improve their performance. Major reductions in radon concentration were realized in all the houses worked on, with most houses with active soil ventilation systems achieving less than 150 Bq/cu m (4 pCi/L) on an annual average basis in the living areas.

19276 **(RFP—4028) Detection of trends, outliers, and releases in environmental monitoring for plutonium at Rocky Flats Plant.** Longbotham, C.R.; Lawton, B.B. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1986. Contract AC04-76DP03533. 23p. (CONF-8608125—5). NTIS, PC A03; 3; GPO Dep. Order Number DE88005281/JAW.

From American Statistical Association meeting; Chicago, IL, USA (18 Aug 1986).

This report summarizes the results of a statistical analysis of plutonium (Pu-239) concentrations from high volume air samplers at the perimeter of Rocky Flats Plant, Golden, Colorado, and in surrounding communities. The purpose of the study was to develop methodologies to detect trends in plutonium concentrations and to detect outliers not indicative of a release of radioactive material. In addition, a methodology was developed to detect conditions indicating a possible release. We summarize the data screening steps employed and give the results of modelling the data for temporal and spatial systematic effects. Results of outlier determination for past data and a recommendation for future outlier detection is included. A proposal for monitoring for trend and local effects is given.

19277 **(SCPRI-RM—2-1987) Monthly results of measurements, February 1987.** (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Mar 1987. 52p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753189/JAW.

This report of the SCPRI exposes an interpretation of the principal results concerning the routine monitoring of environmental radioactivity in France: atmospheric dusts, rainwater, surface water, underground water, sewage water, drinking water, food chain (milk, vegetables, fishes), sea water around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables. This report exposes also the results of special radiation measurements resulting from the Chernobylsk accident.

19278 **(SCPRI-RM—12-1986) Monthly results of measurement, December 1986, with supplement related to 1986 last quarter.** (Service Central de Protection contre les Rayonnements Ionisants, 78 - Le Vesinet (France)). Jan 1987. 78p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87753188/JAW.

This report of the SCPRI exposes an interpretation of the principal results concerning the routine monitoring of environmental radioactivity in France: atmospheric dusts, rainwater, surface water, underground water, sewage water, drinking water, food chain (milk, vegetables, fishes), sea water around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables. This report exposes also the results of special radiation measurements resulting from the Chernobylsk accident.

5005 Site Resource And Use Studies

19279 **(DOE/NV/10384—18) Effects of the length of record on estimates of annual and seasonal precipitation at the Nevada Test Site, Nevada.** French, R.H. (Nevada Univ., Las Vegas (USA). Desert Research Inst.). Jun 1987. Contract AC08-85NV10384. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005454/JAW.

The goal was to examine, in some detail, the effect of the period of record available for analysis on estimates of annual and seasonal precipitation, examine the effect of changing estimates of annual precipitation on estimates of regional groundwater recharge, and to discuss the possibility of a period of severe erosion occurring on the Nevada Test Site in the near future. The conclusions were resonably large changes in the calculated annual and seasonal precipitation must be expected as the period of record available for analysis lengthens; there appears to be a positive trend in the calculated annual precipitation at six of the eleven precipitation stations examined in this study; and in the case of annual precipitation, the variability of precipitation has increased at some stations and has decreased at others as the period of record has lengthened. In the case of seasonal precipitation, the variability of the precipitation has increased at ten of the eleven stations for the summer season and decreased at all stations for the winter season.

19280 **(RFP—4035) Meteorological support at the Rocky Flats Plant.** Hodgin, C.R. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 14 Aug 1986. Contract AC04-76DP03533. 16p. (CONF-8702124—1). NTIS, PC A03. Order Number DE88005145/JAW.

From Workshop on meteorological requirements; Oak Ridge, TN, USA (25 Feb 1987).

The Meteorological Program is responsible for acquiring, archiving, and providing quality assured meteorological data for use in emergency response, meteorological and climatological analyses, atmospheric dispersion modeling, and weather forecasting. The Rocky Flats Plant maintains a network of towers on plantsite; offsite data are obtained through cooperative agreements with governmental agencies.

5006 Regulations

REFER ALSO TO CITATION(S) 19304, 19355

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

19281 **(LA-UR—88-145) The angular reflectance signature of the canopy hot spot in the optical regime.** Gerstl, S.A.W. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 5p. (CONF-880154—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005385/JAW.

From 4. international colloquium on spectral signatures of objects in remote sensing; Aussois, France (18 Jan 1988).

When any three-dimensional surface, e.g. a plant canopy is illuminated by a directional light source such as the sun, an angular reflectance distribution results that shows a narrow intensity peak

in the direction of retro-reflection. This is called the Heiligenschein or hot spot (HS) of vegetation canopies and is caused by the absence of mutual shading of leaves when the observation direction coincides with the illumination direction. The angular intensity distribution of this hot spot, its brightness and contrast against the background, are therefore indicators of the plant's geometry. We show from experimental data and by modeling that the hot spot angular reflectance signature carries information about plant stand architecture that is often more distinctive for different plant species than their spectral signatures. 8 refs., 11 figs.

5101 Basic Studies

REFER ALSO TO CITATION(S) 19103, 19646, 19673, 19682

19282 **(DP-MS—87-111) Vegetation mapping using high resolution MSS [Multispectral Scanner] data: Canopy reflectance and shadow problems encountered and possible solutions.** Jensen, J.R.; Hodgson, M.E.; Pinder, J.; Collins, B.S.; Mackey, H.E. Jr. (South Carolina Univ., Columbia (USA). Dept. of Geography; Colorado Univ., Boulder (USA). Dept. of Geography; Savannah River Ecology Lab., Aiken, SC (USA); Savannah River Lab., Aiken, SC (USA)). 1988. Contract AC09-76SR00819;AC09-76SR00001;AC08-83NV10282. 30p. (CONF-880339—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004273/JAW.

From ASPRS annual meeting; St. Louis, MO, USA (15 Mar 1988).

High resolution Multispectral Scanner (MSS) data were acquired for an old field, successional habitat in South Carolina. The instrument used was a Daedalus Model DS-1268 having 1.5 x 1.5 m spatial resolution and 11 spectral bands. The goal was to map the vegetation of the study area and compute standing biomass. Upon examination of the MSS data, it became apparent that additional information would be required to accurately discriminate between the vegetation types because of (1) nonuniformity of canopy reflectance from individual trees due to sun angle and azimuth, and (2) shadows cast by trees. This paper describes the nature of the canopy reflectance problem, methods of removing the effects of shadows in high resolution MSS data, and the computation of biomass for the study area.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 17783, 17802, 17834, 18136, 18680, 18873, 19111, 19180, 19264, 19334, 19338, 19339, 19639, 19678

19283 **(AD-A—186279/6/XAB) In-situ biological treatment test at Kelly Air Force Base. Volume 3. Appendices. Final report, 1 June 1985-31 May 1987.** Wetzel, R.S.; Durst, C.M.; Davidson, D.H.; Sarno, D.J. (Science Applications International Corp., McLean, VA (USA)). Jul 1987. 211p. NTIS, PC A10/MF A01.

The objective of this project was to field-test in-situ biological degradation for removal of organic contaminants from soils and groundwater. In-situ biological degradation involves stimulation of the indigenous subsurface microbial population by the addition of nutrients and an oxygen source (hydrogen peroxide) to promote degradation of organic contaminants present in soils and groundwater. The results of the test at Kelly AFB allowed for a number of conclusions regarding in situ treatment. The low and variable permeabilities at the test site resulted in a slower delivery of nutrients and oxygen source than anticipated, as well as difficult operating conditions, but did not prevent degradation from occuring. This volume III report includes, in Appendix form, the analytical data collected during the demonstration project and analytical methods used.

19284 **(ANL/EES-TM—340) Hazardous waste land treatment: A technology and regulatory assessment.** Overcash, M.; Brown, K.W.; Evans, G.B. Jr. (Argonne National Lab., IL (USA)). Sep 1987. Contract W-31109-ENG-38. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005571/JAW.

Land treatment is a waste management technology that provides a high level of treatment for some hazardous wastes by using the soil as a treatment medium to degrade, transform, or immobilize waste constituents. It is characterized by very long retention times, and its costs are comparable to or lower than those of other waste treatment or disposal technologies. Also, most land treatment sites can be returned to unrestricted use after closure. Research and field experience for hazardous waste land treatment (HWLT) has demonstrated that a wide range of elements and compounds are treatable in a soil-based system. Also, studies show that heavy metals and organics are unlikely to migrate under HWLT conditions; preliminary studies of emission levels of volatile compounds show that they comply with regulatory requirements. However, because HWLT is regulated as "land disposal" (a term that incorrectly describes it), its widespread adoption is constrained. If hazardous waste regulations are changed to regulate HWLT as a separate treatment technology, it could be further developed and integrated into the US hazardous waste management system.

19285 **(CONF-880343—1) Physical and chemical methods for the characterization of hazardous wastes.** Francis, C.W.; Maskarinec, M.P.; Lee, D.W. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005441/JAW.

From Workshop on land disposal of solid wastes; Gerzensee, Switzerland (14 Mar 1988).

Numerous test methods have been proposed and developed to evaluate the hazards associated with handling and disposal of wastes in landfills. The major concern is the leaching of toxic constituents from the wastes. The fate of hazardous constituents in landfilled wastes is highly dependent on the physical and chemical characteristics of the waste. Thus, the primary objective in the selection of waste characterization procedures should be focused on those methods that gauge the fate of the waste's hazardous constituents in a specific landfill environment. Waste characterization in the United States has centered around the characteristics of ignitability, corrosivity, reactivity, and toxicity. The strategy employed in the development of most regulatory waste characterization procedures has been a pass or fail approach, usually tied to some form of a mismanagement scenario for that waste. For example, USEPA has chosen the disposal of a waste in a municipal waste landfill as a mismanagement scenario for the development of the waste leaching tests to determine the toxicity characteristic. Many wastes, such as large-volume utility wastes or mining wastes, are not disposed of in municipal waste landfills. As a consequence, more effort is needed in the development of waste leaching tests that determine the long-term leaching characteristics of that waste in the landfill environment in which the waste is to be disposed. Waste leaching models also need to be developed and tested as to their ability to simulate actual disposal environments. These models need to be compared with laboratory leaching tests, and, if practical, coupled with groundwater transport models.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 17783, 17794, 17800, 17802, 17804, 17805, 17807, 17808, 17832, 17833, 17843, 18288, 18289, 19273, 19277, 19278, 19344, 19609, 19661

19286 **(AERE-R—12666) Decontamination and reclamation of agricultural land following a nuclear accident. A literature review.** Howorth, J.M.; Sandalls, F.J. (UKAEA Harwell Lab. Environmental and Medical Science Div.). Sep 1987. 50p. H.M. Stationery Office, London, price Pound 5.00.

This report represents a literature review of methods for removing or reducing the potential hazard from /sup 137/Cs and / sup 239/Pu. Each technique is assessed for practicality, efficiency, time, cost and potential adverse consequences. An alternative to removing activity is dilution by mixing contamination into the soil using conventional ploughs. Deep placement using special machinery provides shielding and removes activity from the rooting zone. Root inhibitors may be used to control root uptake. Changes in land management may also be considered. Crops may be planted without prior tillage to control uptake. The use of potassium-based fertilisers has been shown to reduce caesium uptake in low-potassi-

um soils, and the addition of clay minerals might have a similar effect. The production of sensitive crops such as vegetable and fruit could be moved away from the contaminated area and exchanged for sugar, oil crops or forestry. When disposal and storage of waste is considered, the cost of removing surface soil may reach Pound 10,000 per hectare. Ploughing, would cost between Pound 30 and Pound 460 per hectare. Adaptable computer models for cost effective choice have been developed in the US.

19287 **(ANL-OHS/HP—87-101) Removal of radium contaminated soil at the Luminous Processes, Inc. site, Ottawa, Illinois: April-June 1986.** Robinet, M.J.; Mosho, G.D.; Wynveen, R.A. (Argonne National Lab., IL (USA)). Nov 1987. Contract W-31109-ENG-38. 121p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005482/JAW.

The radium and tritium contaminated site formerly occupied by Luminous Processes, Inc. (LPI), a radium dial painting factory, was decontaminated during April-June 1986. The site is located in Ottawa, Illinois. Decontamination of the site consisted of removal of contaminated soil, removal of contaminated foundation and basement walls of a previously demolished building, removal of contaminated sidewalks, and removal of drain lines. The purpose of this report is to describe the site decontamination process and to document that the final radiological condition of the site is acceptable for public use. The principal criterion for acceptability was that the exposure rate everywhere on the site must be no more than 20 μR/h at 1 meter above the soil surface. An addendum is included in this report. The addendum gives the results of a leach test done on contaminated bricks from the exterior of the former Luminous Processes, Inc. building. The leach test was begun in June 1985.

19288 (IA—1427, pp 33-34) **Radioactivity from coal-fired plants.** Tadmor, J. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US-Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19289 **(PB—88-126461/XAB) Superfund Record of Decision (EPA Region 8): Denver Radium/Card Corporation Property, Colorado (third remedial action), June 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Jun 1987. 39p. (EPA/ROD/R—08-87/012). NTIS, PC A03/MF A01.

The Denver Radium/Card Corporation property is a 17.2-acre site located in Denver, Colorado. In 1979, the EPA discovered a reference to the National Radium Institute in 1916 U.S. Bureau of Mines report. Subsequent field research revealed the presence of thirty-one radioactive sites in the Denver Metropolitan area, one of these being Card property, the location of the original Pittsburgh Radium Company processing facility. The site consists of five buildings and an oil and waste water pond at the eastern boundary. There is no serious public health risk at present from radium or its decay products, most notable radion gas. However, there is the potential for increased public health risk if the radium contaminated materials are misused or inadvertently spread. Currently, radium has been detected in the soil, sediment, and underneath the True Truss building. EPA's preferred remedial action for the Card property is permanent offsite disposal. However, the alternative can not be implemented until a suitable offsite facility is designated.

19290 **(SKB-TR—86-24) Migration of thorium, uranium, radium and Cs-137 in till soils and their uptake in organic matter and peat.** Landstroem, O.; Sundblad, B. (Swedish Nuclear Fuel and Waste Management Co., Stockholm; Studsvik Energiteknik AB, Nykoeping (Sweden)). Oct 1986. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752294/JAW.

The distribution of U-238, Th-232, Th-228, Ra-226, Ra-228, Cs-137 and K-40 have been studied in soil and peat samples. Maximum Th and U values in peat were 215 and 248 ppm ash weight, respectively, with Th/U ratios close to 1. An increase of Th and U and decrease of Th/U with depth was observed in the studies peat bog. Disequilibrium of Ra-228/Th-232 are interpreted as current or recent migration of these radionuclides i.e. indirectly of groundwater flow. The main part of Cs-137 in two vertical profiles of the peat bog was found in the lowest zones. Enrichment of Ra isotopes (by the plant nutrient cycle) and differentiation between Ra-228 and Ra-226 in the upper organic zone of soil profiles were observed.

19291 **Geochemistry of nuclear products - natural Tc and Pu.** Curtis, D.B.; Cappis, J.H.; Perrin, R.E.; Rokop, D.J. (Los Alamos National Lab., NM, USA). *Applied Geochemistry;* **2**: No. 1, 133(Jan-Feb 1987). (CONF-8610365—).

From Conference on isotope geochemistry of groundwater and fracture material in plutonic rock; Quebec, Canada (1 Oct 1986).

Abstract only.

19292 **Technetium sorption in surface soils.** Wildung, R.E.; Garland, T.R.; McFadden, K.M.; Cowan, C.E. (Pacific Northwest Lab., Richland, WA, USA). pp 115-129 of Technetium in the environment. Seminar on the behaviour of technetium in the environment held in Cadarache (FR) on 23-26 October 1984. Desmet, G.; Myttenaere, C. (eds.). Barking, England; Elsevier Applied Science Publishers Ltd. (1986). (CONF-8410157—).

From Scientific seminar on the behavior of technetium in the environment; Cadarache, France (23 Oct 1984).

The results of these studies verify the relatively low sorption of Tc (initially as TcO/sub 4//sup -/) under aerobic conditions, even under extended time periods and in soils of elevated organic matter and clay contents. Sorption that occurred was related to soil genesis and soil properties. Sorption was more pronounced in forest-marshland than grassland-shrub soils and was related primarily to pH-dependent sites on both the oxidic Fe and Al and organic matter fractions. The former was most important at time periods < 48 h; the latter was important at the time periods > 48 h. Additional sorption (up to 100%) previously observed in dialysis and and column systems, in which soil was incubated in a moistened state, likely resulted from reduction of TcO/sub 4//sup -/to the much less soluble Tc/sup +4/ and/or microbial uptake. The current investigations suggest that chemical reduction phenomena would be most important as microbial uptake of TcO/sub 4//sup -/ in conjunction with TcO/sub 4//sup -/ sorption would not account for all of the Tc removed from solution in these studies.

19293 **Transfer of /sup 131/I and sup(95m)Tc from pasture to goat milk.** Bondietti, E.A.; Garten, C.T. Jr. (Oak Ridge National Lab., TN, USA). pp 339-347 of Technetium in the environment. Seminar on the behaviour of technetium in the environment held in Cadarache (FR) on 23-26 October 1984. Desmet, G.; Myttenaere, C. (eds.). Barking, England; Elsevier Applied Science Publishers Ltd. (1986). (CONF-8410157—).

From Scientific seminar on the behavior of technetium in the environment; Cadarache, France (23 Oct 1984).

The purpose of this research was to compare the behaviour of /sup 131/I (Tsub(1/2)=8.0d) and sup(95m)Tc (Tsub(1/2)=61d), which were sprayed on to pasture that was subsequently grazed by a herd of dairy goats. The transfer of /sup 131/I to goats milk was about 5600 times more than that of sup(95m)Tc after 5 d of grazing contaminated pasture. Most of the difference appeared to be explained by a progressive immobilisation of technetium on vegetation, which occurred during the first few days of the experiment.

19294 **Significance of environmental exposure pathways for technetium.** Hoffman, F.O.; Gardner, R.H.; Bartell, S.M. (Oak Ridge National Lab., TN, USA). pp 359-376 of Technetium in the environment. Seminar on the behaviour of technetium in the environment held in Cadarache (FR) on 23-26 October 1984. Desmet, G.; Myttenaere, C. (eds.). Barking, England; Elsevier Applied Science Publishers Ltd. (1986). (CONF-8410157—).

From Scientific seminar on the behavior of technetium in the environment; Cadarache, France (23 Oct 1984).

The reasons for the large discrepancies between the results calculated in this analysis and those produced in 1979 (by Till et al.), are (a) data that show the uptake of /sup 99/Tc from soil by field vegetation are from one to two orders of magnitude less than values reported from potted plant greenhouse experiments, (b) data indicating that the transfer of /sup 99/Tc across the gastrointestinal tract of ruminants is several orders of magnitude less than it is for

iodine, and (c) the fact that this analysis accounts for the removal over time of /sup 99/Tc from the root zone of soil. The major difference between the calculational approach of this study and that of the earlier one is the application of numerical simulation (Monte Carlo) techniques, to propagate uncertainties of model parameters through mathematical models of similar structure.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 17709, 17801, 17834, 18362, 19097, 19349, 19675

19295 (EGG—10282-2186) Summary and evaluation of the coyote control program on Naval Petroleum Reserve No. 1, Kern County, California, 1987. Scrivner, J.H. (EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations). Sep 1987. Contract AC08-83NV10282. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004704/JAW.

For the third consecutive year (1987) the US Department of Energy (DOE) funded a coyote (Canis latrans) control program in an attempt to reduce coyote predation on the endangered San Joaquin kit fox (Vulpes macrotis mutica) on Naval Petroleum Reserve No. 1 (NPR-1, Elk Hills) in Kern County, California. During approximately 8 weeks of control activities, personnel from the US Department of Agriculture, Division of Animal Damage Control (ADC), removed 16 adult coyotes: 14 were trapped, 2 were shot. Data were gathered on standard measurements, weights, ages, and reproductive condition. No kit foxes were accidently trapped. Based on the results of canid scent-station surveys, the coyote population on NPR-1 declined and the kit fox population was relatively stable. Recommendations were made to conduct the 1987/1988 coyote control program between December 1987 and February 1988, use helicopters for aerial gunning and locating coyote dens, and develop a cooperative agreement between DOE, ADC, US Fish and Wildlife Service, Bureau of Land Management, and the California Department of Fish and Game to conduct the coyote control program on lands surrounding NPR-1 owned by DOE and others. 8 refs., 2 figs., 2 tabs.

19296 (EGG—10282-2189) Report of endangered species studies on Naval Petroleum Reserve No. 2, Kern County, California. O'Farrell, T.P.; Warrick, G.D.; Mathews, N.E.; Kato, T.T. (EG and G Energy Measurements, Inc., Goleta, CA (USA). Santa Barbara Operations). Sep 1987. Contract AC08-83NV10282. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88004705/JAW.

Between 1983 and 1986 the size of the population of San Joaquin kit foxes (Vulpes macrotis mutica) on Naval Petroleum Reserve No. 2 (NPR-2), Kern County, California, was estimated semiannually using capture-recapture techniques. Although summer population estimates varied between 222 in 1983 and 121 in 1986, and winter estimates varies between 258 in 1984 and 91 in 1983, the population appeared to remain relatively stable at an apparent norm of 165. Kit foxes were abundant even in the intensely developed areas, and numbers and densities (1.12 to 2.49/sq mile) were consistently higher on NPR-2 than on neighboring NPR-1. The percentage of adult vixens that successfully raised pups was 55%, average litter size was 4.0 +- 0.0, and the sex ratio (M:F) of 25 pups was 1:1.5. Most (45.2%) foxes were killed by coyotes (Canis latrans), vehicles killed 6.4%, and 6.5% died of other causes. A cause could not be determined for 41.9% of the deaths. There was a general increase in coyote visitation rates at scent stations, but kit fox visitation rates generally decreased. Kit fox indices were consistently higher on NPR-2 than on NPR-1. Approximately 15% of the kit foxes on NPR-2 dispersed an average of 2.2 +- 0.2 miles. Average dispersal distance did not differ between the sexes. The longest dispersal was 6.9 miles. Proportionately more male than female pups dispersed. Remains of lagomorphs (jackrabbits and cottontails) and kangaroo rats had the highest frequency of occurrence in scats. Frequency of occurrence of lagomorph remains was greater in developed than in undeveloped habitats. Proportions of lagomorph remains increased and kangaroo rat remains decreased between 1983 and 1984. 62 refs., 9 figs., 24 tabs.

5106 Regulations

REFER ALSO TO CITATION(S) 19350, 19352, 19353, 19354, 19355, 19356, 19357, 19358, 19359, 19360, 19361, 19362, 19363

19297 (PB—88-128947/XAB) State of California coastal management program and final environmental impact statement. (National Oceanic and Atmospheric Administration, Rockville, MD (USA). Office of Coastal Zone Management). Aug 1977. 599p. (OCRM—87-24). NTIS, PC A25/MF A01.

It is proposed that the Secretary of Commerce approve the Coastal Management Program application of the State of California pursuant to the Coastal Zone Management Act P.L. 92-583 (as amended). Approval and implementation of the program will provide California with funding that will restrict or prohibit certain land and water uses in parts of the California coast, while promoting and encouraging development and use activities in other parts. This may affect property values, property tax revenues, and resource extraction or exploration. The program will provide an improved decision-making process for determining coastal land and water uses and siting of facilities of national interest, and will lead to increased long-term protection of and benefit the State's coastal resources.

19298 (PB—88-129127/XAB) Louisiana coastal resources program final environmental impact statement. (National Oceanic and Atmospheric Administration, Rockville, MD (USA). Office of Coastal Zone Management). 1980. 388p. (OCRM—87-20). NTIS, PC A17/MF A01.

The State of Louisiana has submitted its Coastal Resources Program to the Office of Coastal Zone Management for approval. Approval would allow program administrative grants to be awarded to the state. Approval and implementation of the program will enhance governance of the state's coastal land and water areas and uses according to the coastal policies and standards. This program will improve decision-making processes for determining appropriate coastal land and water uses. The program will result in some short-term economic impacts on coastal users.

19299 (PB—88-129317/XAB) State of Rhode Island coastal management program and final environmental impact statement. (National Oceanic and Atmospheric Administration, Rockville, MD (USA). Office of Coastal Zone Management). Mar 1978. 530p. (OCRM—87-21). NTIS, PC A23/MF A01.

It is proposed that the Secretary of Commerce approve the Coastal Management Program of the State of Rhode Island pursuant to P.L. 92-583. Approval would permit implementation of the proposed program, allowing program administration grants to be awarded to the State. The State will condition, restrict, or prohibit land and water uses in some parts of the Rhode Island coast, while encouraging development in other parts. Each coastal municipality will retain primary responsibility for managing land use along its coast.

19300 (PB—88-130679/XAB) State of New York coastal management program and final environmental impact statement. (National Oceanic and Atmospheric Administration, Rockville, MD (USA). Office of Coastal Zone Management). Aug 1982. 592p. (OCRM—87-25). NTIS, PC A25/MF A01.

The State of New York has submitted its Coastal Program to the Office of Coastal Zone Management for approval. Approval would allow program administrative grants to be awarded to the State. The document includes a copy of the program which is a comprehensive management program for coastal land-and-water-use activities. It consists of numerous policies on diverse management issues which are administered under existing State laws and is the culmination of several years of program development. New York's coastal policies either promote the beneficial use of coastal resources, prevent their impairment, or deal with major activities that substantially affect numerous resources. The program will improve decision-making processes.

19301 **(PB—88-131370/XAB) Data-quality objectives for remedial-response activities: development process.** (CDM Federal Programs Corp., Annandale, VA (USA)). Mar 1987. 156p. NTIS, PC A08/MF A01.

See also PB—88-131388.

This Compendium provides Superfund Remedial Project Managers (RPM), quality-assurance officers, and State officials with a consolidated ready reference for all remedial field procedures at uncontrolled hazardous-waste sites. It is also intended to contribute to improved consistency in field procedures among the ten EPA Regions.

19302 **(PB—88-131388/XAB) Data-quality objectives for remedial-response activities: example scenario (RI/FS activities at a site with contaminated soils and ground water).** (CDM Federal Programs Corp., Annandale, VA (USA)). Mar 1987. 139p. NTIS, PC A07/MF A01.

See also PB—88-131370.

This Compendium provides Superfund Remedial Project Managers (RPM), quality-assurance officers, and State officials with a consolidated ready reference for all remedial field procedures at uncontrolled hazardous-waste sites. It is also intended to contribute to improved consistency in field procedures among the ten EPA Regions.

19303 **(PB—88-131982/XAB) Commonwealth of Pennsylvania coastal zone management program and final environmental impact statement.** (National Oceanic and Atmospheric Administration, Rockville, MD (USA). Office of Coastal Zone Management). Aug 1980. 360p. (OCRM—87-19). NTIS, PC A16/MF A01.

The State of Pennsylvania has submitted its Coastal Zone Management Program to the Office of Coastal Zone Management for approval. Approval would allow program administrative grants to be awarded to the State. The document includes a copy of the program which is a comprehensive management program for coastal land- and water-use activities. It consists of numerous policies on diverse management issues which are enforced by various State laws. Approval and implementation of the program will enhance governance of the State's coastal land and water areas and uses according to the coastal policies and standards.

19304 **(PB—88-145123/XAB) Superfund Record of Decision (EPA Region 5): Johns-Manville-Waukegan site, Illinois (first remedial action), June 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Jun 1987. 233p. (EPA/ROD/R—05-87/048). NTIS, PC A11.

The Johns-Manville-Waukegan site is located along Lake Michegan in East-Central Lake County, Illinois. The disposal area, or site, covers approximately 120 acres of the approximately 300 acres of land owned by the Manville Service Corporation, formerly the Johns-Manville Sales Corporation. The Manville plant presently produces and has produced a wide range of building materials. Since 1922, waste materials containing primarily asbestos, and to a lesser extent, lead, chrome, thiram, and xylene have been deposited in a variety of pits at the site many of which are no longer in use. Presently, no asbestos or lead is used in the manufacturing process except friable asbestos. Currently active waste disposal pits include: the asbestos disposal pit, which receives friable asbestos wastes from manufacturing building reconstruction activities; the sludge disposal pit, which receives dredged materials from the onsite wastewater treatment system; and the miscellaneous disposal pit in which miscellaneous, non-asbestos-containing wastes are and were deposited.

19305 **(PB—88-145149/XAB) Superfund Record of Decision (EPA Region 6): Crystal City Airport, Zavala County, Texas (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 29 Sep 1987. 58p. (EPA/ROD/R—06-87/023). NTIS, PC A04/MF A01.

The Crystal City Airport (CAA) site, comprising approximately 120 acres, is located in Zavala County, Texas. CCA began operations during World War II as a military installation for transporting and detailing persons of Japanese descent. In 1949, the U.S. Government deeded the airport to Crystal City. Since then, the city has operated the facility as a municipal airport. Several private aerial pesticide-applicating companies conducted business at the airport until 1982. In April 1983, the Texas Department of Water Resources investigated the site because of the potential threat to local residents of waste pesticides left by applicating companies no longer in operation. Surficial soil at the site was found to be highly contaminated with pesticides. In October 1983, an Immediate Removal Action, initiated by the U.S. EPA, consolidated 40 cu. yds of waste and 50-70 drums in two onsite disposal cells. In May 1984, a second removal action disposed of 19 drums offsite and secured the site with a fence. Approximately 12,000 cu. yds of surface soil are contaminated with pesticides including: DDT, toxaphene and arsenic. The selected remedial action includes: onsite consolidation of contaminated soil, drums and buildings; multi-layer RCRA capping; offsite injection well; disposal of decontaminated liquids; and fencing. The estimated present worth cost for the remedy is $1,600,000.

19306 **(PB—88-146808/XAB) Field studies of in-situ soil washing.** Nash, J.H. (Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ (USA)). Dec 1987. 67p. NTIS, PC A04/MF A01.

The EPA and US Air Force conducted a research test program to demonstrate the removal of hydrocarbons and chlorinated hydrocarbons from a sandy soil by in situ soil washing using surfactants. Contaminated soil from the fire-training area of Volk Air National Guard Base, WI, was first taken to a laboratory for characterization. At the laboratory, the soil was recompacted into glass columns creating a simulated in-situ environment. Under gravity flow, 12 pore volumes of aqueous surfactant solutions were passed through each of the columns. Gas chromatograph (GC) analyses were used on the washing effluent and soil to determine removal efficiency (RE). The results of these tests were highly encouraging. Treated effluent was discharged directly to the on-base aerobic-treatment lagoons.

52 ENVIRONMENTAL SCIENCES, AQUATIC

5201 Basic Studies

REFER ALSO TO CITATION(S) 19103, 19326

19307 **(BR—85(14)) Relationship between canal and levee density and coastal land loss in Louisiana.** Turner, R.E. (Louisiana State Univ., Baton Rouge (USA). Center for Wetland Resources). Dec 1987. 71p. US Fish & Wildlife Service, 1010 Gause Blvd., Slidell, LA 70458. Order Number TI88900361/JAW.

Nearly 1% of Louisiana's coastal land becomes water each year. This land loss affects everything from wildlife, fisheries, and recreation to the economy and culture. A part of this loss results from natural, unmanageable factors, but manageable factors are also responsible. This report discusses one of the manageable factors: canals and their dredged-material levees. In coastal Louisiana wetlands, canals are constructed primarily to facilitate navigation and oil and gas recovery. The density of canals in this region is now about equal to the natural network of bayous and creeks. The primary effect of these canals and associated levees is to alter the process of flooding and drainage. The influence of canals and their levees on coastal Louisiana erosion rates are modified by local geologic, hydrologic, and biologic interactions. The empirical relationship between canals and erosion is, however, clear; land loss is directly related to canal density. Comparisons with mosquito ditches, which are smaller analogues of canals, reveal similar patterns of wetland changes and suggest management options.

19308 (DOE/EP/31111—1-Vol.2, pp 3B.1-3B.8) **Checklist of phytoplankton for the Calcasieu River/Lake Complex.** Maples, R.S. 26 Jun 1987. NTIS, PC A21/MF A01. Order Number DE88002684/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 2, Introduction, executive summary, biologi-

cal parameters: Final report, Sampling dates: October 1983-August 1986.

A checklist of phytoplankton taxa for the Calcasieu River/Lake Complex, Louisiana, is presented. A total of 115 taxa representing 61 genera is reported. Chaetoceros, Rhizosolenia, and Nitzschia had the largest number of species. The most frequently-encountered taxa are discussed.

19309 (DOE/EP/31111—1-Vol.2, pp 3D.1-3D.10) **Bluegreen algae as indicators of eutrophication in three bayous of the Calcasieu River/Lake Complex.** Maples, R.S. 26 Jun 1987. NTIS, PC A21/MF A01. Order Number DE88002684/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 2, Introduction, executive summary, biological parameters: Final report, Sampling dates: October 1983-August 1986.

A total of fifteen bluegreen algal taxa were collected in three bayous of Calcasieu Estuary, Louisiana. Eutrophic and mesotrophic species were identified and found to be widespread in all three bayous. The most common taxa were Anacystis montana (Lightfoot) Drouet and Daily, Oscillatoria lutea Ag., Microcoleus lyngbyaceaus (Kutz.) Crouan, and Schizothrix calcicola (Ag.) Gomont. An ecological profile sheet on several common taxa was prepared which included pH, saprobic index, nutrients, halobion, temperature, habitat, and season. Based on the total number of taxa present in the samples, Contraband Bayou and Bayou d'Inde show the greatest tendency toward a eutrophic status.

19310 (DOE/EP/31111—1-Vol.2, pp 3E.1-3E.39) **Phytoplankton ecology of Calcasieu Lake, Louisiana.** Maples, R.S. 26 Jun 1987. NTIS, PC A21/MF A01. Order Number DE88002684/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 2, Introduction, executive summary, biological parameters: Final report, Sampling dates: October 1983-August 1986.

Phytoplankton community structure, biomass, and primary productivity were investigated for Calcasieu Lake, Louisiana. Calcasieu Lake is one of four broad, shallow, turbid estuarine lakes in Calcasieu Estuary. Marine and euryhaline diatoms dominated the phytoplankton community for most of the year with substantial populations of dinoflagellates and microflagellates present in the spring and summer months. Species diversity, redundancy, and niche breadth values were calculated to aid the interpretation of an extremely patchy phytoplankton community. All stations were strongly influenced by tidal circulation and had very high similarity values. Chlorophyll a values were elevated in the summer and winter months. A comparison of water column nutrients with annual chlorophyll a values indicated that nutrients were not a limiting factor for phytoplankton productivity.

19311 (DOE/EP/31111—1-Vol.2, pp 4A.1-4A.32) **Zooplankton in the Calcasieu River/Lake Complex: rationale, general methods, and method verification.** Vecchione, M. 26 Jun 1987. NTIS, PC A21/MF A01. Order Number DE88002684/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 2, Introduction, executive summary, biological parameters: Final report, Sampling dates: October 1983-August 1986.

Chenier-Plain estuaries are unique, yet have not been studied in detail. The zooplankton of one such estuary, the Calcasieu Estuary in southwestern Louisiana, was studied during a 31-month period (September 1983-April 1986) with several objectives. A series of presentations describes (1) long-term patterns in the distribution and abundance of the copepod Acartia tonsa; (2) the distributions of zooplankton in three estuarine bayous that are subject to different anthropogenic stresses; (3) the overall distributional patterns of zooplankton throughout the estuary; and (4) the incidence of ectoparasitic copepods on ichthyoplankton. This paper describes the general methods that were common to all of these projects and presents the results of some projects designed to determine the limits of these data.

19312 (DOE/EP/31111—1-Vol.2, pp 4B.1-4B.17) **Long-term trends in the abundance of Acartia tonsa in the Calcasieu River/Lake Complex.** Vecchione, M. 26 Jun 1987. NTIS, PC A21/MF A01. Order Number DE88002684/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 2, Introduction, executive summary, biological parameters: Final report, Sampling dates: October 1983-August 1986.

Data on the abundance of adult Acartia tonsa are combined from three data sets. These data were all collected by similar methods at two stations in Calcasieu Lake and included samples taken during 51 months over a 132 month period (1975-1986). Both mean abundance and maximum abundance increased by a factor of 2 and then decreased to the original levels during this period. Although there was a slight trend of increasing abundance overall, this trend was not statistically significant. All samples that included high abundances ($> 10{,}000$ individuals m^{-3}) were collected when the water column was not stratified in either salinity or temperature, probably indicating an interaction between wind mixing of this very shallow water column and the vertical distribution of A. tonsa.

19313 (DOE/EP/31111—1-Vol.2, pp 4C.1-4C.35) **Zooplankton distribution in three estuarine bayous of the Calcasieu River/Lake Complex with different types of anthropogenic influence.** Vecchione, M. 26 Jun 1987. NTIS, PC A21/MF A01. Order Number DE88002684/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 2, Introduction, executive summary, biological parameters: Final report, Sampling dates: October 1983-August 1986.

Zooplankton was sampled in three tributaries of the Calcasieu Estuary: one flowing through an area of petrochemical industries, one through a municipal area, and one through an agricultural area. Synoptic comparisons among the bayous were made on eight trips over a two-year period. Additionally, each bayou was sampled intensively for small-scale distribution on four occasions. Numbers of all zooplankton taxa were consistently higher in the agricultural bayou than in either of the other bayous. Patterns of small-scale spatial variability also differed among the bayous. The agricultural bayou appeared to be a relatively healthy estuarine tributary. The municipal bayou was probably subjected to chronic environmental stress that is severe in the vicinity of the municipal sewage and storm-drain outfalls. Evidence indicated that the industrial bayou suffered from frequent, but not continuous, episodes of environmental stress throughout its length.

19314 (DOE/EP/31111—1-Vol.2, pp 4D.1-4D.18) **Zooplankton distribution in the Calcasieu River/Lake Complex.** Vecchione, M. 26 Jun 1987. NTIS, PC A21/MF A01. Order Number DE88002684/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 2, Introduction, executive summary, biological parameters: Final report, Sampling dates: October 1983-August 1986.

This note summarizes the overall distribution of major zooplankton taxa based on six sets of synoptic samples collected at stations throughout the Calcasieu Estuary.

19315 (DOE/EP/31111—1-Vol.2, pp 4E.1-4E.18) **Incidence of ectoparasitic copepods on ichthyoplankton in the Calcasieu River/Lake Complex.** Felley, S.M.; Vecchione, M.; Hare, S.G.F. 26 Jun 1987. NTIS, PC A21/MF A01. Order Number DE88002684/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 2, Introduction, executive summary, biological parameters: Final report, Sampling dates: October 1983-August 1986.

The incidence of ectoparasite copepods on ichthyoplankton in Calcasieu Estuary, Louisiana, was examined. Although relationships between parasitic copepods and fishes are well documented, there have been no studies that deal specifically with infestations on larval or postlarval fishes. In this study, infestations were found in only three taxa: Anchoa sp. (3.6%), Brevoortia sp. (0.2%), and Gobiidae (4.4%). Although 36.4% of the fish examined (n = 27,167)

were larvae, only postlarval fishes were infested. The parasites are believed to be members of the order Siphonostomatoida. The sites of parasite attachment were completely constant within each fish taxon but differed among taxa. The distribution of parasitized fishes was examined in comparison with the overall distribution of the species.

19316 (DOE/EP/31111—1-Vol.2, pp 6.1-6.91) **Nekton assemblages of the Calcasieu River/Lake Complex.** Felley, J.D. 26 Jun 1987. NTIS, PC A21/MF A01. Order Number DE88002684/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 2, Introduction, executive summary, biological parameters: Final report, Sampling dates: October 1983-August 1986.

Species of nekton were sampled monthly by trawl in Calcasieu Lake, a chenier-plain estuary, from October 1983 to August 1986. Additionally, nekton species were sampled monthly by seine in Calcasieu Lake and in three bayous that feed into the estuary, from September 1985 to August 1986. For each sample, number of individuals and total biomass of each species was recorded. Also, individuals of commercially important species (penaeid shrimps, Brevoortia spp., sciaenids) were weighed and measured. For purposes of analysis, three different data sets were defined, as follows: (a) trawl samples from Calcasieu lake; (b) seine samples from calcasieu Lake; and (c) seine samples from three bayous (bayous Choupique, Contraband and d'Inde). For each data set, detrended correspondence analysis (DCA) was performed on a species-by-sample matrix containing numbers of individuals of all species sampled. DCA allowed identification of different nekton assemblages. The analyses demonstrated the importance of seasonal changes in species composition in the estuary and the bayous.

19317 (DOE/EP/31111—1-Vol.3, pp 7.1-7.327) **Hydrology of the Calcasieu River/Lake Complex.** Kjerfve, B.; Sneed, J.E. (Univ. of South Carolina, Columbia). 26 Jun 1987. NTIS, PC A18/MF A01. Order Number DE88002685/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 3, Introduction, executive summary, hydrology: Final report, Sampling dates: October 1983-August 1986.

The main components of this report were: (1) the numerical modeling of circulation and dispersion characteristics in Calcasieu Lake; (2) salt flux computations in the bayous, used as a means of describing the hydrographic features of the inner portions of the Calcasieu system; and (3) time series current meter moorings in Calcasieu Lake. The main accomplishment was the implementation of the hydrodynamic/dispersion model. The model is a vertically-integrated finite-difference, unsteady, full nonlinear numerical model, implemented on a University of South Carolina D.E.C. VAX 11/780 system under VMS. The model is tidally forced at Calcasieu Pass, accepts fresh water input from multiple rivers, and has a homogeneous steady wind stress. Besides yielding flow fields, changes in sea level, salinity, and sediment distributions for Calcasieu Lake were also simulated.

19318 (DOE/EP/31111—1-Vol.4, pp 23, Paper 2) **Ecosystem analysis of the Calcasieu River/Lake Complex: executive summary.** Stevenson, L.H. 26 Jun 1987. NTIS, PC A 25. Order Number DE88002684/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 4, Appendices: Final report, Sampling dates, October 1983-August 1986.

The watershed that drains into the Calcasieu River/Lake Complex has been developed by municipal, industrial, and agricultural interests. In addition, the waterways comprising the bayous, lakes, canals, and river are used extensively for transportation, recreation, commercial and sports fisheries, and waste discharge. Because of the multiple uses of the land and waterways, there is a significant potential for degradation of the system. The Calcasieu Ecosystem project (CALECO) was undertaken in an effort to understand the ecology of the aquatic portion of the Calcasieu Estuary and to evaluate the effects of wastershed development on that ecology.

19319 (NP—8751954) **Criteria of transport and sedimentation of suspended matter in non-banked-up and banked-up running waters. Final report.** Juraschek, M. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Wasserbau). Jul 1986. 45p. (In German). NTIS (US Sales Only), PC A03. Order Number DE88751954/JAW.

Experimental investigations were carried through on the uniformity and steadiness of fluid flow and transport under marginal conditions excluding sedimentation. The maximum concentration of suspended particles that can be transported in turbulent flow through a flume with a firm, plane sole without leading to sedimentation was determined and the correlation with the energy of the turbulent movement pointed out. Flow, sediment, and coarseness parameters were varied within large boundaries. For the experiments aiming to determine the criteria of sedimentation a firm sole of the flume was chosen to exclude possible interaction between erosion and sedimentation. Furthermore experiments with a fully movable sole were conducted aiming at an exemplary quantification of the basic influence of the sole's erodibility and deformability on steady-state transport.

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REFER ALSO TO CITATION(S) 17645, 17710, 17724, 19283, 19641, 19642, 19689, 19690

19320 (CONF-8710141—4) **A Lagrangian-Eulerian approach to modeling hydrogeochemical transport of multi-component systems.** Yeh, G.T.; Tripathi, V.S. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004738/JAW.

From International conference on groundwater contamination; Amsterdam, Netherlands (26 Oct 1987).

For advection-dominated hydrogeochemical transport problems, negative concentration can occur especially in sharp front cases when traditional numerical methods of finite element or finite difference are used to solve the governing equations. Negative concentration, in addition to being illogical, also gives two undesired effects. It can easily tumble into nonconvergent solutions or existing chemical equilibrium models are unable to deal with negative concentrations. A Lagrangian-Eulerian approach is employed to overcome the problems of negative concentration. In this approach, one adopts a Lagrangian viewpoint when dealing with the advective terms and an Eulerian viewpoint when dealing with all other terms in the hydrogeochemical transport equations. However, in general the fictitious Lagrangian particles will not coincide with the grid nodes. Thus, the accuracy of the advective step is contingent on the means by which a concentration value of a fictitious particle is approximated by that of the node values surrounding the particle. It is shown that a linear interpolation is equivalent to the upstream weighting scheme with the Courant number less than or equal to one. Other nonlinear interpolations are explored to increase the accuracy in the Lagrangian step of dealing with the advection terms. Several examples are used to demonstrate the utility and versatility of the Lagrangian-Eulerian approach to solving hydrogeochemical transport problems. 9 refs.

19321 (DOE/EP/31111—1-Vol.1, pp 1A.1-1A.37) **Water and sediment quality in the Calcasieu River/Lake Complex.** Murray, H.E. 26 Jun 1987. NTIS, PC A18/MF A01. Order Number DE88002683/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 1, Introduction, executive summary, physicochemical parameters: Final report, Sampling dates: October 1983-August 1986.

A two-year (October 1983-December 1985) intensive study of the Calcasieu River/Lake Complex was undertaken to determine the presence of anthropogenic substances, and to estimate their impacts on the estuary. Results from water measurements indicated that Bayou d'Inde had the great variation in BOD, TOC, alkalinity, fecal strep, temperature and DO as compared to all other sites that were sampled, while Choupique Bayou had the lowest. High water quality parameters measured upstream in the bayous did not appear to degrade the overall water quality of the estuary.

19322 (DOE/EP/31111—1-Vol.1, pp 1B.1-1B.43) **Special pollutants in the Calcasieu River/Lake Complex.** Murray, H.E.; Beck, J.N. 26 Jun 1987. NTIS, PC A18/MF A01. Order Number DE88002683/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 1, Introduction, executive summary, physicochemical parameters: Final report, Sampling dates: October 1983-August 1986.

The objective of this study was to survey the Calcasieu River/Lake Complex for the presence of synthetic organic compounds, and to establish which classes of these compounds pose a potential threat to the health of the system. This two and a half year study (January 1984-Aug 1986) revealed that the concentrations of all organic pollutants detected varied widely in their values. The sporadic and uneven distributions of chemical compounds appeared to be typical of what might be expected with environmental analysis of organic pollutants. Analyses of this study suggested that the upper portion of the estuarine system (including the bayous) have the highest concentrations of pollutants (particularly the chlorinated pesticides). No single station was highest or lowest in regard to all pollutants measured.

19323 (DOE/EP/31111—1-Vol.1, pp 2A.1-2A.7) **Chemistry of the Calcasieu River/Lake Complex.** Beck, J.N. 26 Jun 1987. NTIS, PC A18/MF A01. Order Number DE88002683/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 1, Introduction, executive summary, physicochemical parameters: Final report, Sampling dates: October 1983-August 1986.

The Calcasieu River/Lake Complex located in southwestern Louisiana has long been affected by human activity. These impacts include the extensive channelization and dredging of the river from the Gulf of Mexico to Lake Charles. The resulting intrusion of salt water into the ship channel has adversely affected the general water quality upstream to Lake Charles. Further degradation of the general water quality has occurred due to the introduction of human waste and industrial pollutants to the river since the industrial, primarily petrochemical, and urban expansion of the area since the 1940's. Existing data for the Calcasieu River/Lake Complex consist mainly of reconnaissance sampling and monitoring to investigate a particular stress such as depressed dissolved oxygen content of the river. These studies by their nature are not sufficient in themselves to clearly define long-term changes occurring in the system as a whole. A comprehensive study of pollutant levels and fates of those pollutants is required to determine impacts upon the entire ecosystem.

19324 (DOE/EP/31111—1-Vol.1, pp 2C.1-2C.44) **Heavy-metal contamination in the Calcasieu River/Lake Complex, Louisiana.** Beck, J.N.; Ramelow, G.J.; Thompson, R.S.; Mueller, C.S.; Webre, C.; Carmouche, E.; Young, J.C.; Langley, M.P. 26 Jun 1987. NTIS, PC A18/MF A01. Order Number DE88002683/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 1, Introduction, executive summary, physicochemical parameters: Final report, Sampling dates: October 1983-August 1986.

The heavy metals As, Cd, Cr, Cu, Pb, Hg, Ag, and Zn were measured in surficial sediments at permanent stations located in the Calcasieu River/Lake Complex. The relationships among metal concentrations in different areas of the system was investigated to determine sources, source strength, and transport. The point-source inputs of heavy metals were assumed to be industrial outfalls and sewage outfalls. Although these inputs have not seriously affected the entire river/lake complex, stressed regions exist within each bayou.

19325 (DOE/EP/31111—1-Vol.1, pp 2D.1-2D.18) **Mercury in the Calcasieu River/Lake Complex, Louisiana.** Mueller, C.S.; Ramelow, G.J.; Beck, J.N.; Murray, H.E. 26 Jun 1987. NTIS, PC A18/MF A01. Order Number DE88002683/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 1, Introduction, executive summary, physicochemical parameters: Final report, Sampling dates: October 1983-August 1986.

Total Hg concentration was determined in water, sediment, and biota at selected stations throughout the Calcasieu River/Lake Complex, including three bayous that drain into the Calcasieu River. Water Hg levels were low throughout the system (< 0.1 μg L^{-1}) and were found above detection limits only during the period from April to June 1984. Biota generally contained Hg at detectable levels (averaging about 0.25 mg kg^{-1}, dry weight). Bayou d'Inde was found to have the heaviest burden of Hg in surficial sediment (up to 1.1 mg kg^{-1}). Mercury was not present above the detection limit of 0.005 mg kg^{-1} at stations located in Choupique Bayou and Calcasieu Lake. Core samples were collected in Bayou d'Inde to yield a profile for the changes in Hg concentration in the past.

19326 (DOE/EP/31111—1-Vol.1, pp 2E.1-2E.36) **Spatial and temporal variation of heavy metals in sediment cores from the Calcasieu River/Lake Complex.** Mueller, C.S.; Ramelow, G.J.; Beck, J.N. 26 Jun 1987. NTIS, PC A18/MF A01. Order Number DE88002683/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 1, Introduction, executive summary, physicochemical parameters: Final report, Sampling dates: October 1983-August 1986.

Sediment cores were obtained from several locations in the Calcasieu River/Lake Complex, including Calcasieu Lake, Calcasieu River, two bayou tributaries, and Lake Charles during the period from November 1983 to November 1985. The cores were analyzed for Cu, Zn, Cr, and Pb. The approximate sedimentation rate and a core chronology were determined by the use of ^{137}Cs and ^{210}Pb isotopes. The increase in metal concentrations after 1933, particularly along Bayou d'Inde where most industries are located, points to anthropogenic input if these metals to the system. The fact that metal concentrations tend to merge to a common value prior to 1940 throughout the system suggests that geological factors do not contribute to the observed variations in metal concentrations in this area. The background concentrations of heavy metals found in this study for the Calcasieu River/Lake Complex were: Cu (10 mg kg^{-1}), Cr (25 mg kg^{-1}), Pb (8 mg kg^{-1}), and Zn (40 mg kg^{-1}). The main emphasis of the study focused along Bayou d'Inde due to the enhanced levels of heavy metals found.

19327 (DOE/EP/31111—1-Vol.1, pp 2F.1-2F.21) **Periphyton as monitors for heavy metal pollution inn the Calcasieu River/Lake Complex.** Ramelow, G.J.; Maples, R.S.; Thompson, R.L.; Mueller, C.S.; Webre, C.; Beck, J.N. 26 Jun 1987. NTIS, PC A18/MF A01. Order Number DE88002683/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 1, Introduction, executive summary, physicochemical parameters: Final report, Sampling dates: October 1983-August 1986.

The levels of the heavy metals As, Cd, Cr, Cu, Pb, Ag, and Zn were determined in periphyton specimens obtained with a diatometer collector. Stations were selected along three important bayous of the Calcasieu River system. Distributions of some of these metals in the organisms were similar to those found in sediments from the same locations, while those of other metals appeared to be similar to metal concentrations in water. Concentration ratios for periphyton to sediment greatly exceeded one for the metals As, Cd, Cr, Ag, and Zn, suggesting enrichment of these metals in periphyton. The concentrations of heavy metals in the periphyton appeared to yield more information about pollutants than either water or sediment samples collected at the periphyton stations.

19328 (DOE/EP/31111—1-Vol.1, pp 2J.1-2J.7) **Heavy metals and nutrient concentrations in water collected in the Calcasieu River/Lake Complex.** Beck, J.N.; Ramelow, G.J.; Webre, C.; Mueller, C.S.; Thompson, R.S.; Young, J.; Langley, M.P. 26 Jun 1987. NTIS, PC A18/MF A01. Order Number DE88002683/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 1, Introduction, executive summary, physicochemical parameters: Final report, Sampling dates: October 1983-August 1986.

Concentrations of the heavy metals As, Cd, Cr, Cu, Pb, Hg, Ag, and Zn and the nutrients NH_3, $NO_2 + NO_3$, PO_4, and O-PO_4 were measured in water samples at 36 stations located in the Calcasieu River/Lake Complex. Samples were collected during the period from October 1983 to May 1986. Arsenic was not found above the detection limit of 20 $\mu g\ L^{-1}$ at any station. Silver was only detected in water samples collected from the Calcasieu River and Calcasieu Lake at concentrations ranging from 1 to 3 $\mu g\ L^{-1}$. Mercury was detected in water samples during the period from April to June 1984 across the study area. Concentrations of the remaining metals varied among sampling cruises but variations were not due to point sources. These variations probably resulted from changes in water quality due to storm runoff or tidal effects. Concentrations of the nutrients NH_3, $NO_2 + NO_3$, PO_4 and O-PO_4 were relatively constant across the study area except for elevated concentrations found in Contraband and d'Inde bayous. These bayous contributed nutrients to the remainder of the Calcasieu River/Lake Complex.

19329 (DOE/EP/31111—1-Vol.2, pp 3C.1-3C.17) **Diatoms as indicators of water quality in three bayous of the Calcasieu River/Lake Complex.** Maples, R.S. 26 Jun 1987. NTIS, PC A21/MF A01. Order Number DE88002684/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 2, Introduction, executive summary, biological parameters: Final report, Sampling dates: October 1983-August 1986.

A total of 99 periphytic diatom taxa were collected in three bayous of Calcasieu Estuary, Louisiana. Eutrophic and mesotrophic species were identified and found to be widespread in all three bayous. The most common eutrophic taxa were Cyclotella meneghiniana Kutz., Gomphonema parvulum Kutz., Nitzschia ganderscheimiensis Krasske and Nitz. palea (Kutz.) W. Sm. The absence of pollution-sensitive taxa and high autotrophic index values in Contraband Bayou indicated that this bayou was at a critical level of eutrophication. The pollution was attributed to a sewage outfall near the mouth of Contraband Bayou, urban runoff, urban activities (e.g., discarding grassclippings in the bayou), and summer stagnation of the water column.

19330 (DOE/EP/31111—1-Vol.2, pp 5A.1-5A.11) **Introduction and methods.** Gaston, G.R. 26 Jun 1987. NTIS, PC A21/MF A01. Order Number DE88002684/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 2, Introduction, executive summary, biological parameters: Final report, Sampling dates: October 1983-August 1986.

The distribution and abundance of macrobenthic organisms in the Calcasieu Estuary were examined in order to characterize benthic communities in various habitats of the area. The study was divided into several components concerning various aspects of the ecology of benthic species. The macrobenthos are those macroscopic benthic organisms that are retained on a 0.5 mm screen sieve following rinsing. Generally considered good indicators of pollution, they are especially important in assessing impacts of pollutants that remain on or over estuarine sediments.

19331 (DOE/EP/31111—1-Vol.4, pp 12, Paper 1) **Introduction.** Stevenson, L.H. 26 Jun 1987. NTIS, PC A 25. Order Number DE88002686/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 4, Appendices: Final report, Sampling dates: October 1983-August 1986.

This report describes research undertaken in an attempt to understand the basic ecology of the Calcasieu River/Lake Complex. In addition, an attempt is made to evaluate the effects of human activities on that ecology. Part of the work involved surveying the Calcasieu Estuary for the presence of anthropogenic substances as well as analyses of the effects of human activities on the biotic communities within the estuary. The field sampling and monitoring were conducted from October 1983 through August 1986.

19332 (DOE/ER/60351—3) **Nearshore transport processes affecting the dilution and fate of energy-related contaminants: Summary progress report, January 1985-December 1987.** Blanton, J.O. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 1 Dec 1987. Contract FG09-85ER60351. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004808/JAW.

This contract is one of several components in the DOE regional program of Coastal Oceanography in the southeastern US, hereafter called the South Atlantic Bight (SAB). Three major field experiments have been completed. The first was conducted March-June, 1985 in support of the DOE Spring Runoff Experiment (SPREX). A paper summarizing the results of this effort is presently submitted and under review. We also conducted a pilot field experiment in autumn of 1986 as a precursor to the major autumn effort called FLEX (FaLl EXperiment). The field plans of both of the autumn experiments are described together with a summary of findings for the autumn 1986 work. 20 refs., 6 figs., 4 tabs.

19333 (DP-MS—86-174) **Well volume evacuation versus pH, conductivity, volatile organic chlorocarbon and metal concentrations for selected monitoring wells on the Savannah River Plant.** Lorenz, R.; Price, V. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1988. Contract AC09-76SR00001. 14p. (CONF-880235—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003319/JAW.

From NWWA ground water geochemistry conference; Denver, CO, USA (16 Feb 1988).

In assessing the effectiveness of the SRP ground-water remediation program, the collection of valid hydrologic and groundwater data is essential. Currently, there is no single universally recognized way to collect ground-water samples. However, the accuracy of various methods can be verified for almost all sites when sufficient knowledge is gained concerning the constituents of interest and the ground-water chemistry. Bailers and submersible pumps represent the two most widely used techniques. The selection of an appropriate sampling technique is highly dependent on, but not limited to, ground-water flow rate, well depth, constituent(s) of interest, hydrogeologic conditions, and ground-water chemistry. A 3-test study was conducted to determine the amount of water that should be purged from SRP wells before sample collection. The first test consisted of measuring specific conductance and pH as a function of well volume on 157 monitoring wells. A minimum quantity of four well volumes was evacuated. The depths of these wells ranged from 45 to 250 feet. The second test consisted of repeating the first test on ten monitoring wells with the addition of the collection of samples for VOC analysis. The third test involved sampling three of the wells with the highest contamination. During this test pH, conductivity, VOC, and selected metal concentrations were determined. The purpose of this paper is to present the data obtained in this study, to discuss our findings, and to present a case study that demonstrates the need for understanding local groundwater chemistry and for well evacuation before sample collection.

19334 (GKSS—87/E/34) **Wet and dry deposition of heavy metals on the island of Pellworm.** Stoessel, R.P. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Hamburg Univ. (Germany, F.R.). Fachbereich Geowissenschaften; GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik). 1987. 156p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88751948/JAW.

Wet and dry atmospheric deposition of ecologically relevant trace elements (e.g. Cu, Zn, Pb, Cd, Ni) was investigated over a fourteen-month period on the island of Pellworm in the German Bight. Precipitation and size-separated aerosol samples were taken in weekly intervals. The amount of trace elements was determined by total-reflection X-ray fluorescence analysis. Dry deposition results were obtained using the concentration method. For methodological comparison, total sedimentation was measured using two different samplers. With the techniques used, atmospheric deposition onto the island of Pellworm was determined. The data allow an estimate of the input of airborne trace elements into the North Sea. With 42 figs., 8 tabs..

19335 (NP—8770039, pp 489-496) **Development of high performance separation membrane composite methane gas production apparatus.** Takeda, Shoji. (Aqua Renaissance Research Association, Tokyo, Japan). 19 Sep 1986. (In Japanese). NTIS (US Sales Only), PC A21. Order Number DE88770039/JAW.

In Proceedings of parallel sessions for the 6th NEDO general assembly.

The Research and Development of Consolidated Water Revitalization and Utilization System , which is the six year project starting from 1985, has the objectives to process home and industrial sewage highly efficiently by applying biotechnology and membrane separation technology so that biogas may be produced efficiently and sewage may be reutilized as water resources. This article is an outline of the development which is the combination of a highly efficient bioreactor and membrane separation technology and constitutes the characteristic features of significant increase of the methane recovery and highly efficient methanization by increased density of microorganisms inside the reactor. As the results, the followings are expected; highly efficient recovery of such resources as methane gas etc., energy saving during the operation and maintenance of the apparatus, reduction of sludge production, miniaturization of the processing facilities and grading-up the quality of the processed water etc. The individual subjects for development are membrane module for methane production, new bioreactor for methane production, and measurement and control system for methane fermentation. A consolidated investigation and research of methane fermentation is also to be done. During the period of 1989-1990, a pilot plant will be constructed and through its operation tests using actual sewage, the technology necessary for the practically usable system will be established. (1 fig, 4 tabs)

19336 (PB—88-126438/XAB) **Numerical model for three-dimensional, variable-density hydrodynamic flows: documentation of the computer program.** Paul, J.F.; Nocito, J.A. (Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab.). Nov 1987. 241p. (EPA—600/3-87/042). NTIS, PC A11/MF A01.

As part of a research effort by the U.S. Environmental Protection Agency to study the dispersion of pollutants in aquatic systems, a numerical model was developed that is capable of realistically describing the hydrodynamics in lakes, embayments, nearshore marine coastal areas, and riverine and thermal outfall plumes. The model is time-dependent, three-dimensional, and variable density. Both rigid-lid and free-surface flows can be determined. The main assumptions used in the development of the model include hydrostatic-pressure variation, Boussinesq approximation, and eddy coefficients to account for turbulence. A new solution procedure, which is a modification of the simplified marker and cell method, is used. The procedure permits selected terms in the equations to be treated implicitly in time. The report provides the documentation for the computer program for the numerical model.

19337 (PB—88-126446/XAB) **Biological aerated-filter full-scale EPA (Environmental Protection Agency) demonstration project.** Stensel, H.D.; Lee, K. (Utah Univ., Salt Lake City (USA)). 1983. 7p. NTIS, PC A02/MF A01.

Pub. in Proceedings of the Utah Water Pollution Control Association 1983 Annual Meeting, Park City, UT., April 20-21, 1983.

The use of high-rate fixed-film biological wastewater-treatment processes is gaining considerable interest as an alternative to activated sludge treatment. Much of the interest is related to the potential for smaller reactor volumes due to the ability to maintain a high concentration of biological solids, the elimination of sludge-control problems associated with activated-sludge clarifiers, and the potential for simple operation. The Biological Aerated Filter (BAF) is a high-rate packed-bed fixed-film system marketed by the Eimco Process Equipment Company and recently developed by OTV of Paris, France. The purpose of this paper is to describe a BAF system, the project objectives, the system start-up experience, and initial performance.

19338 (PB—88-126990/XAB) **Behavior and impact assessment of heavy metals in estuarine and coastal zones.** Salomons, W.; Kerdijk, H.; van Pagee, H.; Klomp, R.; Schreur, A. (Waterloopkundig Lab. te Delft (Netherlands)). Jan 1987. 50p. (DELFT-HYDRAULICS-COM—375). NTIS, PC E03/MF A01.

Contents include: introduction; river systems; physical processes; chemical processes; estuaries and coastal zone; introduction; physical processes; chemical processes; the role of sediments; introduction; the anoxic layer; major-element chemistry; minor-element chemistry; the oxic-anoxic interface; assessment; introduction; analysis of sediments; modelling.

19339 (PB—88-128061/XAB) **Hydrology and pollutant-removal effectiveness of wetland buffer areas receiving pumped agricultural drainage water.** Chescheir, G.M.; Gilliam, J.W.; Skaggs, R.W.; Broadhead, R.G.; Lea, R. (North Carolina Water Resources Research Inst., Raleigh (USA)). Aug 1987. 187p. (UNC-WRRI—87-231). NTIS, PC A09/MF A01.

The hydrology and pollutant-removing effectiveness of two wetland areas being used to buffer impacts of pumped agricultural drainage in Eastern North Carolina were studied. Collection and analysis of field data over a two-year period showed that buffer one, originally equipped with an efficient diffuser canal, was essentially 100% effective for pollutant removal for all observed events. A routine was added to calculate residence time of the water on the buffer and percent removal of nutrients. Hourly surface and subsurface field-drainage volumes calculated by a water-management model. The two models estimated that over a 20-year period, study buffer one would remove 79% of total Kjeldahl nitrogen, 82% of nitrate nitrogen, 81% of total phosphorus, and 92% of sediment.

19340 (PB—88-130257/XAB) **Field evaluation of in-situ biodegradation for aquifer restoration. Interim report, October 1985-October 1987.** Semprini, L.; Roberts, P.V.; Hopkins, G.D.; Mackay, D.M. (Stanford Univ., CA (USA). Dept. of Civil Engineering). Nov 1987. 66p. NTIS, PC A04/MF A01.

The in-situ remediation of aquifers contaminated with halogenated aliphatic compounds is a promising alternative in efforts to protect ground water. The report presents the experimental methodology and the initial results of a field experiment evaluating the feasibility of in-situ biotransformation of TCE and related compounds. The method being tested relies on the ability of methane-oxidizing bacteria to degrade these contaminants to stable end products. The test zone is a shallow, confined aquifer located at the Moffett Naval Air Station, Mountain View, California.

19341 **New method for determining the concentrations of volatile organic compounds in sediment interstitial water.** Knezovich, J.P.; Harrison, F.L. (Lawrence Livermore National Lab., CA). *Bulletin of Environmental Contamination and Toxicology;* **38**: No. 6, 937-940(Jun 1987). Contract W-7405-ENG-48.

The bioaccumulation of sediment-sorbed organic contaminants is likely to be mediated by the transfer of chemical through interstitial water. Unfortunately, laboratory studies of sediment-sorbed chemical bioavailability have either not assessed chemical concentrations in interstitial water or have utilized methods that required disruption of the sediment layers. The authors report here a simple method for the removal of interstitial water samples with an in situ technique. This method can be used to determine relevant exposure concentrations in laboratory studies of sediment-sorbed chemical bioavailability and toxicity.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 17835, 17843, 18290, 19273, 19277, 19278, 19289, 19290, 19320, 19609, 19661

19342 (AERE-R—11912) Studies of environmental radioactivity in Cumbria. Part 10. Some radionuclides in nearshore seawater 1980-1984. McKay, W.A.; Pattenden, N.J.; Branson, J.R. (UKAEA Harwell Lab. Environmental and Medical Science Div.; Department of the Environment, London (UK)). Sep 1987. 59p. H.M. Stationery Office, London, price Pound 6.00.

The main objective of this study was to determine the concentrations and ratios of actinides in suspended particulates as they vary with time and place, and to relate these with the known discharges to sea from Sellafield. The actinides in seawater suspended particulate are thought to be a major source for the sea-to-land transfer mechanism. Seawater was collected from the shore at a number of locations within 40 km of Sellafield between December 1980 and May 1984. Over 90% of the Pu and Am in these intertidal waters was found to be associated with the suspended particulate (cf < = 30% for /sup 137/Cs), a reflection of the high concentration factor of actinides onto sediments and the high particulate loadings in these waters. The suspended particulate actinide activities were very variable, partly reflecting changes in fine particulate content and partly due to the incorporation of Pu and Am discharged in earlier years. Using an empirical exponential model to estimate the availability of Pu after discharge, a mean time of between 6 and 9 years in intertidal suspended particulate for these waters is suggested. Some small areas of relatively intense alpha activity were observed in samples of suspended particulate material. They contributed about 5% to the total alpha activity of the particulate.

19343 (DOE/EP/31111—1-Vol.1, pp 2I.1-2I.20) **Radioactivity in the Calcasieu River/Lake Complex.** Broussard, M.; Beck, J.N. 26 Jun 1987. NTIS, PC A18/MF A01. Order Number DE88002683/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 1, Introduction, executive summary, physicochemical parameters: Final report, Sampling dates: October 1983-August 1986.

Concentrations of natural and manmade radionuclides including ^{40}K, ^{137}Cs, ^{226}Ra, ^{228}Ac, and their decay products were measured in sediment and water samples. Gross alpha and gross beta activities were also determined in water samples. The levels of radioactivity were found to be low in all water samples, with a general increase of activity toward the brackish waters of the southern portion of the study area. The concentrations of uranium and thorium daughters found in sediment samples were found to be relatively constant across the study area. The concentration of ^{40}K was found to vary in a regular manner, with the lowest values found in the northern portion of the river/lake complex and highest values found at the southern stations. This suggests transport and deposition of potassium into the organic-rich sediments. The only manmade radionuclide found was ^{137}Cs which was deposited only in the top 15 to 20 cm of sediment and was uniformly distributed across the sample area.

19344 (EPA—520/5-87-009) Radiological survey of the Charleston Naval Base and Shipyard and the Charleston Naval Weapons Station. Smith, J.M. (Environmental Protection Agency, Montgomery, AL (USA). Eastern Environmental Radiation Facility; Environmental Protection Agency, Washington, DC (USA). Office of Radiation Programs). Jul 1987. 17p. US Environmental Protection Agency, Office of Radiation Programs, 401 M St. SW, Washington, DC 20460. Order Number TI88900450/JAW.

This report presents results of the survey conducted by Eastern Environmental Radiation Facility (EERF) personnel to assess levels of environmental radioactivity resulting from maintenance and operation of nuclear-powered warships at the Charleston Naval Base and Shipyard and the Charleston Naval Weapons Station, near Charleston, South Carolina. The purpose of the survey was to determine if operations related to nuclear powered warship activities resulted in release of radionuclides which may contribute to significant population exposure or contamination of the environment. 4 refs., 5 figs., 3 tabs.

19345 (IAEA-R—4292-F) Assessment of the impact from transporting radioactive materials in the Suez Canal. Final report for the period December 1985 - December 1986. Sabek, G. (International Atomic Energy Agency, Vienna (Austria)). Nov 1987. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701293/JAW.

A study in Egypt, carried out as the subject of an IAEA research contract, has used the INTERTRAN Code to provide an assessment of doses to handlers and the collective dose to the population, due to transport of radioactive material through the Suez Canal. Calculations were carried out using the data appropriate to the Canal, based on actual statistics and observations and default data built into the Code. The average collective dose per year was calculated to be 4.5 man rem and doses to handlers under normal transport conditions represented 97% of the total. Use of built-in default data gave results 10/sup 6/ times higher. 11 refs, 16 tabs.

19346 (LBL—24537) Some effects of data base variations on numerical simulations of uranium migration. Carnahan, C.L. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 21p. (CONF-870965—5). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005453/JAW.

From International conference on chemistry and migration behavior of actinides and fission products in the geosphere; Munich, F.R. Germany (14 Sep 1987).

Numerical simulations of migration of chemicals in the geosphere depend on knowledge of identities of chemical species and on values of chemical equilibrium constants supplied to the simulators. In this work, some effects of variability in assumed speciation and in equilibrium constants were examined, using migration of uranium as an example. Various simulations were done of uranium migration in systems with varying oxidation potential, pH, and mator component content. A simulation including formation of aqueous species UO_2^{2+}, $UO_2CO_3^0$, $UO_2(CO_3)_2^{2-}$, $UO_2(CO_3)_3^{4-}$, $(UO_2)_2CO_3(OH)_3^-$, UO_2^+, $U(OH)_4^0$, and $U(OH)_5^-$ is compared to simulation excluding formation of UO_2^+ and $U(OH)_5^-$. These simulations relied on older data bases, and they are compared to a further simulation using recently published data on formation of $U(OH)_4^0$, $(UO_2)_2CO_3(OH)_3^-$, $UO_2(CO_3)_3^{5-}$, and $U(CO_3)_5^{6-}$. Significant differences in dissolved uranium concentrations are noted among the simulations. Differences are noted also in precipitation of two solids, $USiO_4$(c) (coffinite) and $CaUO_4$(c) (calcium uranate), although the solubility products of the solids were not varied in the simulations. 18 refs., 9 figs., 2 tabs.

19347 (PB—88-130042/XAB) Low-cost/low-technology aeration techniques for removing radon from drinking water. Environmental research brief. Kinner, N.E.; Lessard, C.E.; Schell, G.S.; Fox, K.R. (Environmental Protection Agency, Cincinnati, OH (USA). Water Engineering Research Lab.). Sep 1987. 9p. (EPA—600/M-87/031). NTIS, PC A02/MF A01.

Simple treatment techniques designed as low-cost/low-technology aeration techniques were investigated as to determine their effectiveness for the removal of radon from drinking water. The techniques investigated consisted of flow through storage and minimal aeration in various configurations and were found to be effective in varying degrees for the reduction of radon. These low-cost/low-technology aeration techniques may be easily applied in small communities.

19348 Behaviour of technetium in freshwater environments. Blaylock, B.G.; Frank, M.L.; Hoffman, F.O.; DeAngelis, D.L. (Oak Ridge National Lab., TN, USA). pp 79-89 of Technetium in the environment. Seminar on the behaviour of technetium in the environment held in Cadarache (FR) on 23-26 October 1984. Desmet, G.; Myttenaere, C. (eds.). Barking, England; Elsevier Applied Science Publishers Ltd. (1986). (CONF-8410157—).

From Scientific seminar on the behavior of technetium in the environment; Cadarache, France (23 Oct 1984).

One objective of the current study was to determine the concentration of sup(95m)Tc in zooplankton, aquatic insects and other lower-trophic-level components of an experimental pond. These data were incorporated with data from previous experimental pond studies to obtain a better understanding of the bioaccumulation of technetium in freshwater organisms. A second objective was to estimate variability by comparing the bioaccumulation of technetium in freshwater organisms with that of marine organisms.

5204 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 18196

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 17831, 18362

19349 **(DP—1745) The Savannah River and its environs: Proceedings of a symposium in honor of Dr. Ruth Patrick for 35 years of studies on the Savannah River.** (Savannah River Lab., Aiken, SC (USA)). Dec 1987. Contract AC09-76SR00001. 99p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88003930/JAW.

The symposium was focussed on the interrelationships of Savannah River Plant operations and the environment of the Savannah River area. Environmental programs at the Savannah River Plant site began with baseline measurements before plant startup and continued with data collection into the 1980's. (ACR)

5206 Regulations

REFER ALSO TO CITATION(S) 19297, 19298, 19299, 19300, 19301, 19302, 19303, 19304, 19305

19350 **(PB—88-126479/XAB) Superfund Record of Decision (EPA Region 6): Cleve Reber, Ascension Parish, Louisiana (first remedial action), March 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 31 Mar 1987. 69p. (EPA/ROD/R—06-87/020). NTIS, PC A04/MF A01.

The Cleve Reber site is located in Ascension Parish between Baton Rouge and New Orleans, Louisiana. Originally a burrow pit for the construction of a local highway, it was subsequently used as a landfill for both municipal and industrial waste. There are an estimated 6400 drums buried at shallow depths on this 24.6-acre site. The site ties within a 100-year flood plain and the area surrounding the site may fall within the wetlands classification. The site currently contains four surface water ponds. Between 1970 and 1974, it was used as a landfill for both municipal and industrial waste. No records of the waste received at the site are available. The wastes were reportedly segregated into municipals, chemical waste piles, and landfilled. Numerous drums containing chemical wastes were buried onsite. Volatile chemical wastes during handling and disposal reportedly resulted in nausea and illness to the landfill employees. In 1974, the site was abandoned and in 1979 declared an abandoned hazardous waste site by the State. In 1983, the State fenced in the site due to local concern; and in July 1983, EPA conducted an emergency removal.

19351 **(PB—88-126487/XAB) Superfund Record of Decision (EPA Region 6): Highland Acid Pit, Harris County, Texas (second remedial action), June 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 26 Jun 1987. 38p. (EPA/ROD/R—06-87/021). NTIS, PC A03/MF A01.

See also report dated Sep 84, PB—85-214005; Portions of this document are not fully legible.

The Highlands Acid Pit site is located 16 miles east of Houston on a 6-acre peninsula in Harris County, Texas. The site is bordered on the west and south by the San Jacinto River, on the north by a wooded area, and on the east by a sand pit. The site lies within the 10-year flood plain and has subsided 2.4 feet since 1964. An unknown quantity of industrial waste sludge was disposed of at the site in the 1950s. The sludge is believed to be spent sulfuric wastes from a refinery process. The June 1984 Record of Decision, addressing the source of contamination, was inadequate to evaluate the full extent of ground-water contamination. The primary contaminants of concern addressing ground water include VOCs and heavy metals. The recommended remedial action includes a no action remedy with long-term ground water and surface water monitoring since the contaminants of concern were not detected above criteria levels. The capital cost for the monitoring program is $4,700 with annual O&M of $6,980.

19352 **(PB—88-126495/XAB) Superfund Record of Decision (EPA Region 4): Tower Chemical Company Site, Clermont, Florida, July 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 9 Jul 1987. 87p. (EPA/ROD/R—04-87/022). NTIS, PC A05/MF A01.

The Tower Chemical Company (TCC) site is an abandoned manufacturing facility located along the eastern edge of Lake County, Florida. The TCC owned and utilized two separate parcels of land: a main facility and a spray-irrigation field. Approximately 16 residences, located within a 1.2-mile radius of the site, tap the underlying aquifer for their water supply. Wetlands and swamps are also nearby the site. From 1957 to 1981, the TCC manufactured, formulated and stored various pesticides. Acidic wastewaters, produced during the manufacturing process were discharged into the unlined percolation/evaporation pond located at the main facility. In July 1980, the pond overflowed and discharge was diverted to the spray irrigation field. In June 1980, as a result of damages caused by the wastewater pond overflow, the Florida Department of Environmental Regulation (FDER) ordered TCC to cease all discharges from the site studies, initiated by both EPA and FDER, indicated high concentrations of DDT and associated pesticide compounds in the main facility and a below normal fish population in the unnamed stream onsite.

19353 **(PB—88-126511/XAB) Superfund Record of Decision (EPA Region 4): Tri-City Conservationist Corporation Site, Temple Terrace, Florida (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 21 Sep 1987. 41p. (EPA/ROD/R—04-87/023). NTIS, PC A03/MF A01.

The Tri-City property, occupying approximately one-quarter acre, is located in Temple Terrace, Hillsborough County, Florida. The site is located within one-fourth mile of at least eight private drinking water wells and within two miles of major public-drinking-water supply wells. From 1960 to 1975 the Tri-City property was used for the operation of a heating-oil service business. From 1978 to 1983, Tri-City Oil Conservationist Corporation was a waste oil collection and distribution center. During the operational period of the Tri-City site, the Hillsborough County Environmental Protection Commission and the Florida Department of Environmental Regulation (FDER) received several complaints regarding odor problems and sloppy practices. In 1982, a 3000-gallon waste oil spill occurred at the Tri-City operation. The owner failed to clean up the site at the request of FDER and in February 1984, EPA conducted an immediate removal action. Following the removal, soil contamination posed a threat to the ground water.

19354 **(PB—88-126529/XAB) Superfund Record of Decision (EPA Region 3): Saltville Waste Disposal Site, Saltville, Virginia (remedial alternative selection), June 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Jun 1987. 92p. (EPA/ROD/R—03-87/035). NTIS, PC A05/MF A01.

The Saltville Waste Disposal site is located along the North Fork of the Holston River (NFHR) between Saltville and Allison Gap in Western Smyth County, Virginia, and partly extends into Washington County, Virginia. The Jefferson National Forest is located approximately one-half mile north of the site. From 1895 to 1972, Olin Corporation and its predecessors (Mathieson Chemical Corporation and Mathieson Alkali Works) used the site for various chemical manufacturing operations. The site includes a former plant area and two waste ponds, 5 and 6. Between 1951 and 1972, the Olin Corporation operated an electrolytic chlorine and caustic soda plant which released mercury into the process wastes and onto the plant grounds. Mercury losses were estimated by Olin Corporation

to be 100 lbs/day from the chlor-alkali processes. In 1963, Waste Pond 6 was constructed to receive waste overflow from Waste Pond 5. According to Olin corporation, no wastes containing mercury were dumped into Waste Pond 6, but structural components of the old plant reportedly were buried at the eastern edge of the pond.

19355 **(PB—88-126537/XAB) Superfund Record of Decision (EPA Region 3): Palmerton Zinc Site, Palmerton, Pennsylvania (interim remedial measure), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 4 Sep 1987. 36p. (EPA/ROD/R—03-87/036). NTIS, PC A03/MF A01.

The Palmerton Zinc site is located in Carbon County, Pennsylvania. The New Jersey Zinc Company currently operates two zinc smelters in Palmerton at the base of Blue Mountain. These two smelters are referred to as the east and west plants. Since 1898, the New Jersey Zinc facility has produced zinc and other metals for machinery, pharmaceuticals, pigments and many other products. Primary smelting of concentrated zinc-sulfide ores which was terminated in December 1980, is the main source of pollution. Prior to December 1980, the smelters emitted huge quantities of zinc, lead, cadmium, and sulfer dioxide which led to the defoliation of approximately 2000 acres on Blue Mountain, adjacent to the east smeltor. Vegetation damage first appeared on a 1951 aerial photograph as isolated patches on the steep, north-facing slope of Blue Mountain located immediately south of the east plant. By 1985, vegetation damage progressed over a continuous widespread area leaving barren, eroded land visible. The primary contaminants of concern leading to the defoliation of Blue Mountain include: zinc, lead, cadmium and sulfur dioxide.

19356 **(PB—88-126552/XAB) Superfund Record of Decision (EPA Region 2): Volney Landfill Site, Volney, New York (first remedial action), July 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 31 Jul 1987. 68p. (EPA/ROD/R—02-87/040). NTIS, PC A04/MF A01.

The Volney Landfill site, located in the Town of Volney, Oswego County, New York, is a 55-acre, unlined municipal landfill. From 1969 until 1983 municipal-waste disposal operations occurred at the site. Most of the waste disposed of at the site consisted of typical residential, commercial, institutional, and light industrial waste. However, between March 1974 and January 1975, Pollution Abatement Services, a hazardous-waste incineration facility, was permitted to dispose of approximately 8000 drums containing only residue coatings. Allegedly, 50 - 200 of these drums contained unidentified liquid waste. The condition of these alleged drums is unknown, as is their location within the landfill. In September 1983, waste disposal at the landfill ceased with the opening of the Bristol Hill Landfill approximately 2 miles southeast of the site. In the fall of 1985, closure operations for the Volney Landfill were completed by the current owner, Oswego County. Because the landfill is unlined and has a leachate collection system only in its newer (northern) section, leachate migration is occurring in both horizontal and vertical directions. The primary contaminants of concern affecting the ground water include: vinyl chloride, benzene, arsenic, VOCs and metals.

19357 **(PB—88-131669/XAB) Oregon coastal management program, 1976.** (National Oceanic and Atmospheric Administration, Rockville, MD (USA). Office of Coastal Zone Management). 31 Jan 1977. 506p. (OCRM—87-26). NTIS, PC A22/MF A01.

Contents include: Gubernatorial review and approval; Statewide land-use-planning statutes; Summary of compliance acknowledgement, extensions, and grant requests; Statewide planning goals and guidelines; State statutes and authorities; Summary of standards in statewide planning goals and state statutes; Significant court decisions; Public involvement and program development; List of public hearings and meetings; List of meeting with state and federal agencies; Documentation of compliance with air- and water-pollution-control requirements; Summary of inventories, from OCCDC final report; Summary of critical areas, from OCCDC final report; and Status of federal lands in Oregon's coastal zone.

19358 **(PB—88-145081/XAB) Superfund Record of Decision (EPA Region 1): Davis Liquid Waste Site, Smithfield, Rhode Island (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 29 Sep 1987. 158p. (EPA/ROD/R—01-87/022). NTIS, PC A08/MF A01.

The Davis Liquid Waste site is located in a rural section of the Town of Smithfield, Providence County, Rhode Island. The 15-acre site, bounded on the north and south by wetlands and swamp areas, is within one-half mile of 38 homes. Throughout the 1970s, the site served as a disposal location for various hazardous liquid and chemical wastes including: paint and metal sludge; oily wastes; solvents; acids; caustics; pesticides; phenols; halogens; metals; fly ash; and, laboratory pharmaceuticals. Liquid wastes were accepted at the site in drums and bulk tank trucks and were dumped directly into unlined lagoons and seepage pits. The dumping has resulted in soil, surface and ground water contamination that still persists. Periodically the semi-solid lagoon materials were excavated and dumped in several onsite locations and covered with available site soil. Other site operations included the collection of junked vehicles, machine parts, metal recycling, and tire shredding. In 1977 the discovery of offsite well contamination prompted the State Superior Court to prohibit dumping of hazardous substances on the Davis property.

19359 **(PB—88-145099/XAB) Superfund Record of Decision (EPA Region 2): Chemical Control Corporation, Elizabeth, New Jersey (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 23 Sep 1987. 51p. (EPA/ROD/R—02-87/041). NTIS, PC A04/MF A01.

See also report dated Sep 83, PB—85-213684; Portions of this document are not fully legible.

The Chemical Control Corporation (CCC) site, consisting of 2.2 acres and a portion of the Elizabeth River, is located in Union County, New Jersey. The site area, formerly a marsh, is flat and barely above sea level. The surrounding area is mostly industrial. However, one residence is within 200 feet of the site. Densely populated neighborhoods are located across the Elizabeth River. From 1970 to 1978, CCC operated as a hazardous-waste storage, treatment, and disposal facility accepting various types of chemicals including: acids, arsenic, bases, cyanides, flammable solvents, PCBs, compressed bases, biological agents, and pesticides. Throughout its operations, CCC was cited for discharge and waste-storage violations. In March 1979, the State of New Jersey initiated a site cleanup of bulk solids and liquids, drums at and below the surface, gas cylinders, infectious wastes, radioactive wastes, highly explosive liquids, debris, tanks and three feet of soil. Excavated soil areas were replaced with a three foot gravel cover.

19360 **(PB—88-145107/XAB) Superfund Record of Decision (EPA Region 2): Suffern Village Well Field, Suffern, New York (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 25 Sep 1987. 50p. (EPA/ROD/R—02-87/042). NTIS, PC A03/MF A01.

The Suffern Village Well Field site is located in Rockland County, New York. The Village of Suffern operates four production wells that provide water to approximately 12,000 people. In September 1978 monitoring activities detected 1,1,1-trichloroethane (TCEA), a common industrial chemical compound, and trace VOCs in the municipal water distribution system. In December 1978, wells 1,2 and 4 with TCEA levels of 90-114 ppb were shut down. Municipal water-supply requirements were met by well 3. A subsequent survey identified the Tempcon Corporation, a small local oil burner reconditioning business, as the source of TCEA. In January 1979, Tempcon ceased using a seepage disposal pit and TCEA-based cleaning products. By March 1979, removal of waste material and excavation and devolatilization of contaminated soils were completed. A spray aeration treatment system was then implemented to remove TCEA from the municipal water supply. Monitoring results indicate TCEA levels in the four wells below the New York State Department of Environmental Conservation (NYSDEC) guideline of 50 ppb.

19361 **(PB—88-145115/XAB) Superfund Record of Decision (EPA Region 4): Sodyeco Site, Charlotte, North Carolina (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 24 Sep 1987. 67p. (EPA/ROD/R—04-87/024). NTIS, PC A04/MF A01.

The Southern Dyestuff Company (Sodyeco) site, located in Mecklenburg County, North Carolina, consists of approximately 1,300 acres. Approximately 20-30 residents reside within a one-quarter mile radius of the site, while many of the areas 9,137 residents commute daily to the site for employment. The site contains an operating manufacturing facility consisting of production units, a waste-water-treatment area and materials storage areas. Approximately 1040 acres are underdeveloped. Sodyeco began operations at the site in 1936. In 1958, American Marietta (which became Martin Marietta in 1961) purchased the site and expanded the company's liquid sulfur dye production to include the manufacture of vat and disperse dyes and specialty products for agrochemical, electronic, explosive, lithographic, pigment, plastic, rubber and general chemical industries. The Sandoz Chemical Company purchased the plant in 1983. Five CERCLA facilities, identified as A, B, C, D and E, were identified as probable sources of the ground water and soil contamination.

19362 **(PB—88-145131/XAB) Superfund Record of Decision (EPA Region 5): Seymour Recycling Corporation site, Seymour, Indiana (second remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 30 Sep 1987. 58p. (EPA/ROD/R—05-87/050). NTIS, PC A04/MF A01.

The Seymour Recycling Corporation (SRC) site, encompassing a fourteen-acre area, is approximately two miles southwest of Seymour, Indiana. SRC and its corporate predecessor, Seymour Manufacturing Company, processed, stored, and incinerated chemical wastes at the site from about 1970 to early 1980. The facility was closed when SRC failed to comply with a 1978 agreement with the State of Indiana to cease receiving wastes and to institute better waste-management practices. In 1980, several thousand drums were removed from the site by two potentially responsible parties (PRPs). In 1981, the U.S. EPA removed chemicals from tanks at the site and disposed of those wastes offsite. A 1982 Consent Decree with potential PRPs resulted in the removal, between December 1982 and January 1984, of approximately 50,000 drums, 100 storage tanks and the first foot of contaminated soil from about 75 percent of the site's surface. A Record of Decision, signed in September 1986, evaluated the stabilization of the ground water plume emanating from the site and selected the implementation of a plume stabilization system to extract, treat and discharge ground water to a waste water treatment plant.

19363 **(PB—88-145156/XAB) Superfund Record of Decision (EPA Region 10): Colbert Landfill, Washington (first remedial action), September 1987. Final report.** (Environmental Protection Agency, Washington, DC (USA)). 29 Sep 1987. 128p. (EPA/ROD/R—10-87/010). NTIS, PC A07/MF A01.

The Colbert Landfill, a 40-acre county-owned sanitary landfill is located in Spokane County, Washington. From 1968 through 1986, the landfill received both municipal and commercial wastes. During five years, from 1975 to 1980, a local electronics manufacturing company, Key Tronic Corporation, disposed of several hundred gallons per month of spent organic solvents, mainly methylene chloride and 1,1,1-trichloroethane (TCA) at the landfill. These wastes were typically brought to the landfill in drums and poured down the sides of open trenches to mix with the soil or ordinary municipal refuse already in the trench. During the same period, Fairchild Air Force Base, disposed of various solvent wastes at the site. Pesticides and refinery tar residues were also disposed on site, but to date, these contaminants have not been detected in the ground water. In 1980, nearby residents complained to the Eastern Regional Office of the Washington Department of Ecology about these disposal practices.

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

REFER ALSO TO CITATION(S) 18246

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 18381, 18388

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 17711, 19297, 19298, 19299, 19300, 19303

19364 **(DOE/EA—0288) Liberty-Parker No. 2 230-kV transmission line project, La Paz and Maricopa Counties, Arizona: Environmental assessment.** (USDOE Western Area Power Administration, Washington, DC). Sep 1986. 70p. NTIS, PC A04. Order Number DE88005006/JAW.

The proposed project was not found to have the potential for significant impact on the human environment. The proposed project is essentially a rebuild of an existing transmission line on an existing right-of-way (ROW) through mostly unpopulated open desert. Analysis of the proposed action and its potential effects on various environmental components showed that the project would not significantly affect climate, air quality, noise levels, topography, geology, or soils. No significant impact would occur to vegetation or wildlife as a result of the project. Visual resources will not be significantly affected, as both the existing Liberty-Parker No. 2 Transmission Line and its parallel sister No. 1 line are already present. Land ownership, land use, and socioeconomics will not be significantly affected. No significant cultural resources will be affected by the proposed project. The lines will be constructed on areas previously surveyed for cultural resources and the site density of this region is known to be very low.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5501 Behavioral Biology

REFER ALSO TO CITATION(S) 19644

5502 Biochemistry

REFER ALSO TO CITATION(S) 17636, 17992, 18002, 18003, 19442, 19575, 19576, 19586, 19637, 19646

19365 **Kinetic analysis of adsorption processes.** Brendel, V.; Perelson, A.S. (Theoretical Biology and Biophysics, Los Alamos National Lab., Los Alamos, NM 87545). *SIAM Journal on Applied Mathemadics;* **47**: No. 6, 1306-1319(Dec 1987).

The authors derive the explicit solution to a kinetic model proposed by J. Gani or the reversible attachment of antibodies to viruses. This model generally applies to the reversible adsorption of monovalent particles to binding sites on cell surfaces. Assuming that all binding sites are equivalent, that adsorbed particles do not interact, and that initially no particles are bound, they derive an explicit expression for the number of cells with i bound particles as a function of time. Two special cases are considered in detail: (i) irreversible adsorption, and (ii) adsorption when the number of particles greatly exceeds the number of binding sites. Applications to problems arising in somatic gene therapy and cell-mediated cytotoxicity are discussed.

19366 **(LBL—23958) Scanning transmission x-ray microscopy of unaltered biological specimens.** Iskander, N. (Lawrence Berkeley Lab., CA (USA)). May 1987. Contract AC03-76SF00098. 64p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005736/JAW.

A scanning transmission x-ray microscope at the National Synchrotron Light Source was used to image fresh, wet biological specimens at 32 Angstroms, with resolution better than 750 Angstroms. A gold Fresnel zone plate (outer zone width 500 Angstroms) was used to focus the undulator radiation, and the sample was scanned through the spot. Absorption data was recorded digitally as a gridded array. The major accomplishment of the experiment was the demonstration of the ability to image biological samples in their natural state with high resolution and natural elemental contrast mechanisms. This was achieved through the design of a sample holder that maintains an aqueous environment for the sample, yet is transparent to x-rays at 32 Angstroms. The specimens used were isolated zymogen granules (approximately 1 micron diameter) from the pancreatic acinar cells of rats. The absorption data were correlated to protein concentration, and estimates of the protein concentrations within the granules were obtained. The data also yields some information about the spatial organization of the protein in the granules, and our data is compared to models for the internal structure. The success of this experiment points toward future opportunities for dynamical studies on living systems. 6 refs., 28 figs., 2 tabs.

5503 Cytology

REFER ALSO TO CITATION(S) 18816, 19590, 19591, 19592, 19608, 19619, 19663

5504 Genetics

REFER ALSO TO CITATION(S)-17993, 19554, 19582, 19583, 19584, 19589

19367 **(DOE/ER/13204—T1) [Genetics of thermophilic bacteria]: Progress report, May 1, 1987-December 20, 1987.** Welker, N.E. (Northwestern Univ., Evanston, IL (USA)). 1987. Contract FG02-84ER13204. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004426/JAW.

The goal of this project is the genetic analysis of Bacillus stearothermophilus NUB36. Optimal conditions were sought for chromosomal DNA transformation of protoplasts and transduction. Towards this goal a shuttle vector for cloning in B. stearothermophilus NUB36 was constructed. 2 refs.

19368 **(LA-UR—87-4022) The GenBank database and the flow of sequence data for the human genome.** Burks, C. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 8p. (CONF-8709214—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004315/JAW.

From Workshop on biotechnology and the human genome: innovations and impacts; Upton, NY, USA (14 Sep 1987).

An overview of the GenBank database is provided. Topics discussed include data entry, database access, the use of the data, and the goals of the database. (DT)

5505 Metabolism

REFER ALSO TO CITATION(S) 17903, 17996, 19576, 19645

19369 (INIS-SU—432, pp 564) **Inclusion of /sup 14/C-stearic acid in general lipids of rat tissues and blood serum in the dynamics of experimental tumors development.** Tagi-Zade, S.B.; Orudzhli, R.N.; Ilizarova, N.R.; Dzhafarov, G.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

5506 Medicine

REFER ALSO TO CITATION(S) 18833, 19605, 19608, 19615, 19616, 19616

19370 **(CEA-CONF—8929) Investigation of myocardial receptors by PET in heart diseases.** Syrota, A. (CEA, 91 - Orsay (France). Service Hospitalier Frederic Joliot). Oct 1986. 18p. (CONF-8610318—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753198/JAW.

From Workshop on clinical efficacy of positron emission tomography; Koeln, F.R. Germany (23 Oct 1986).

Changes in number and/or affinity of cardiac neurotransmitter receptors have been associated with myocardial ischemia and infarction, congestive heart failure, cardiomyopathy, as well as diabetes or thyroid-induced heart muscle disease. These alterations of cardiac receptors have been demonstrated in vitro on membrane homogenates from samples collected mainly during surgery or post mortem. The disadvantage of these in vitro binding techniques is that receptors lose their natural environment and their relationships with the other components of the tissue. With the advent of Positron Emission Tomography (PET) it is now possible to obtain non-invasively quantitative determination of regional biochemical processes in the heart. The feasibility of characterizing muscarinic acetylcholine receptors, beta-adrenergic receptors and α/sub 1/-adrenergic receptors has been shown in animals and in man. The receptor PET technique begins to be applied to clinical investigation.

19371 **(DOE/ER/60407—2) Biomedical research with cyclotron produced radionuclides: Progress report, February 1, 1987-September 30, 1987.** Laughlin, J.S.; Bading, J.R.; Balis, M.E.; Benua, R.S.; Brennan, M.F.; Gelbard, A.S. (Sloan-Kettering Inst. for Cancer Research, New York (USA)). 1987. Contract FG02-86ER60407. 63p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004662/JAW.

The long-term objectives of the program are to develop minimally invasive methods for in vivo measurement of specific physiologic and metabolic parameters, and with those methods contribute to the understanding of the pathophysiology of cancer, and improved management of cancer patients. The specific aims of the work described in this report are the development of methodology for measuring regional amino acid transport, metabolism and protein incorporation in tumors, and non-malignant tissues using C-11 and N-13 labeled amino acids; the use of F-18 labeled fluoropyrimidines as imaging agents to aid the design and evaluation of regional and systemic chemotherapeutic strategies in human adenocarcinoma of the intestinal tract; thedevelopment of methodology for studying angiogenesis and amino acid utilization in human glioma; and the evaluation of C-11 alpha-aminoisobutyric acid as an imaging agent for assessment of hepatic function in human jaundice and amino acid transport in human tumors. 55 refs., 21 figs., 3 tabs.

19372 **(INIS-mf—11621) Brain metastases. Computed tomographic results and clinical processes.** Spielmann, D. (Freie Univ. Berlin (Germany, F.R.)). 16 Apr 1982. 127p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88752244/JAW.

Using 155 patients with brain metastases the clinical symptoms, disease courses and computed tomographic results were evaluated. The primary tumors were in the lungs (40%), the mammary gland (20%), the gastrointestinal tract (8%), melanoblasts (7%) or were not known (13%). The survival times after the appearance of neurological symptoms were 4 months (50%), 1 year (20%) and 2 years (5%). The median survival time in the cases of the lung tumors was about 3 months, with mammary tumors 5 months, and with metastasizing melanomas 3 months. Association of the metastases to the brain regions, solitary and multiple infections as well as the density of metastases in computed tomograms were investigated. The average survival times of patients with brain metastases which did not deposit any contrasting agent were clearly longer, with spot-forming metastases clearly shorter. The larger the perifocal edema, the shorter the survival time. Clinical and computed tomographic evaluation of therapy success showed various results. An improvement in the clinical symptomatology occurred in 90% of the cases with corticoid therapy, in 56% of the cases after irradiation of the brain metastases and in 37% after operative interven-

tion. In contrast to this the computed tomographic control examination showed a therapeutic improvement of the pathological brain changes in only about 40% of the treated cases, while a progression in 50% of all irradiated cases and in 42% of the operated cases was to be seen.

19373 (INIS-SU—432, pp 175-176) **Radioimmunoassay in diagnosis of pretumor diseases of stomach, colon and rectum.** Blokhina, N.G. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19374 (INIS-SU—432, pp 194) **Monoclonal antibodies in serologic diagnosis of malignant tumors.** Tkacheva, G.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19375 (INIS-SU—432, pp 201-202) **Computerized tomography and retrograde cholangiography in diagnosis of cancer of extrahepatic biliary ducts and Vater's papilla.** Ajtkazin, M.A.; Grushin, Yu.V.; Aliev, R.M.; Manasov, T.Zh. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19376 (INIS-SU—432, pp 216) **Role of radiodiagnostic methods in treatment planning of uterus cancer in patients.** Baranov, S.B.; Skudrit, G.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19377 (INIS-SU—432, pp 227-228) **Radionuclide in-vivo in-vitro assessment of bone system state in the course of complex treatment of patients with lymphogranulomatosis.** Bykov, S.A.; Artyushkin, A.V.; Lapchenkov, V.I.; Volkov, A.A.; Blank, M.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19378 (INIS-SU—432, pp 228) **Radiolymphography in diagnosis of regional lymph nodes injuries in case of melanoma.** Bykov, S.A.; Zhukova, L.A.; Anisimov, V.V.; Tarkov, A.S. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19379 (INIS-SU—432, pp 352) **To the problem of expediency of new neoplastic models formation for screening diagnostic radiopharmaceuticals.** Savel'eva, O.P. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19380 (INIS-SU—432, pp 371-372) **Radionuclide methods of diagnosis of kidney neoplasm.** Tkachuk, V.N.; Napalkov, P.N. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19381 (INIS-SU—432, pp 379) **Application of scintigraphic methods complex for diagnosis of neoplasms dissemination of thyroid and for controlling treatment efficiency.** Fadeev, N.P.; Matezius, I.G. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19382 (INIS-SU—432, pp 304) **Diagnosis of retinoblastomas using thermography and Ga/sup 67/ citrate scintigraphy.** Lenskaya, O.P.; Belkina, B.M. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19383 (INIS-SU—432, pp 320) **Functional state of kidneys and liver in combined treatment of rectum neoplasm.** Mishchenko, T.N.; De, S.E. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19384 (INIS-SU—432, pp 519-520) **Contribution of radioimmunological indices in assessment of neoplasm - organism system in case of monitoring of gastrointestinal tract neoplasms.** Ivashkin, A.V.; Prus, E.S.; Azizov, I.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19385 (INIS-SU—432, pp 528) **Revealing expression of surface antigen associated with herpes simplex virus in man tumor cells.** Kosyakov, P.N.; Pavlyuchenkova, R.P.; Kosyakova, N.P.; Posevaya, T.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19386 (INIS-SU—432, pp 583) **Increase of diagnostic value in case of pigment skin neoplasms by complex radionuclide diagnosis.** Baramidze, T.G.; Tavdoradze, Ch.M.; Piradashvili, D.Z.; Sapiashvili, A.O. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19387 (INIS-SU—432, pp 584-586) **Radioimmunological microanalysis in assessment of dissemination and efficiency of malignant tumours treatment.** Burenin, I.S.; Tkacheva, G.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19388 (LBL—23322) **A multichannel, high linearity current digitizer for digital subtraction angiography.** Nakamura, M.; Katz, J.E.; Thompson, A.C. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098;AC02-76CH00016. 6p. (CONF-871006—28). NTIS, PC A02. Order Number DE88004549/JAW.

From Nuclear science symposium; San Francisco, CA, USA (21 Oct 1987).

An experiment studying the application of synchrotron radiation for transvenous coronary angiography requires special electronics to read out a 600 element Si(Li) detector. To obtain high image quality, the electronic system must digitize the current in all 600 elements every 2 ms with a dynamic range of 40,000 and a

maximum non-linearity of 0.02%. Each channel of electronics contains a current-to-voltage amplifier with computer controlled grain and offset followed by a voltage-to-frequency converter used in the reciprocal counting mode. A high speed digital readout method using a lookup table, digital multiplier and direct memory interface was developed. The entire system has been designed to have a low cost per channel and to be easily expanded to 1200 signal channels. 6 refs., 6 figs.

19389 **Structure of the manganese complex of photosystem II upon removal of the 33-kilodalton extrinsic protein: an X-ray absorption spectroscopy study.** Cole, J.L.; Yachandra, V.K.; McDermott, A.E.; Guiles, R.D.; Britt, R.D.; Dexheimer, S.L.; Sauer, K.; Klein, M.P. (Lawrence Berkeley Lab., CA). *Biochemistry;* **26**: No. 19, 5967-5973(22 Sep 1987). Contract AC03-76SF00098.

The structure of the Mn complex of photosystem II (PSII) was studied by X-ray absorption spectroscopy. Oxygen-evolving spinach PSII membranes containing 4-5 Mn/PSII were treated with 0.8 M $CaCl_2$ to extract the 33-, 24-, and 16-kilodalton (kDa) extrinsic membrane proteins. Mn was not released by this treatment, but subsequent incubation at low Cl^- concentration generated preparations containing 2 Mn/PSII. The Mn X-ray absorption K-edge spectrum of the $CaCl_2$-washed preparation containing 4 Mn/PSII is very similar to the spectrum of native PSII, indicating that the oxidation states and ligand symmetry of the Mn complex in these preparations are not significantly different. The Mn extended X-ray absorption find structure (EXAFS) of $CaCl_2$-washed PSII fits to a Mn neighbor at $\sim$ 2.75 A and two shells of N or O at $\sim$ 1.78 and $\sim$ 1.92 A. The results demonstrate that the structure of the Mn complex is largely unaffected by removal of 33-, 24-, and 16-kDa extrinsic proteins, and thus these proteins do not provide ligands to Mn. The Mn K-edge spectrum of the $CaCl_2$-washed sample containing 2 Mn/PSII has a dramatically altered shape, and the edge infection point is shifted to lower energy. The position of the edge is consistent with a Mn oxidation state of +3. The Mn EXAFS of this preparation is also quite different and cannot be simulated by using the parameters for the native Mn complex. Thus the structure of the Mn complex is disrupted upon depletion of half of the Mn.

19390 **Comparison of the structure of the manganese complex in the S_1 and S_2 state of the photosynthetic O_2-evolving complex: an X-ray absorption spectroscopy study.** Yachandra, V.K.; Guiles, R.D.; McDermott, A.E.; Cole, J.L.; Britt, R.D.; Dexheimer, S.L.; Sauer, K.; Klein, M.P. (Lawrence Berkeley Lab., CA). *Biochemistry;* **26**: No. 19, 5974-5981(22 Sep 1987). Contract AC03-76SF00098.

A Mn-containing enzyme complex is involved in the oxidation of H_2O to O_2 in algae and higher plants. X-ray absorption spectroscopy is well suited for studying the structure and function of Mn in this enzyme complex. Results of X-ray K-edge and extended X-ray absorption fine structure (EXAFS) studies of Mn in the S_1 and S_2 states of the photosynthetic O_2-evolving complex in photosystem II preparations from spinach are presented in this paper. The S_2 state was prepared by illumination at 190 K or by illumination at 277 K in the presence of 3-(3,4-dichlorophenyl)-1,1-dimethylurea (DCMU); these are protocols that limit the photosystem II reaction center to one turnover. Both methods produce an S_2 state characterized by a multiline electron paramagnetic resonance (EPR) signal. An additional protocol, illumination at 140 K, produces a state characterized by the $g = 4.1$ EPR signal. The authors have previously observed a shift to higher energy in the X-ray absorption K-edge energy of Mn upon advancement from the dark-adapted S_1 state to the S_2 state produced by illumination at 190 K. The Mn K-edge spectrum of the 277 K illuminated sample is similar to that produced at 190 K, indicating that the S_2 state is similar when produced at 190 or 277 K. A similar edge shape and an edge shift of the same magnitude are seen for the 140 K illuminated sample. These results indicate that the $g = 4.1$ signal arises from oxidation of the Mn complex and that the structural differences between the species responsible for the $g = 4.1$ signal and the multiline EPR signal are subtle. They conclude from the edge and EXAFS studies that the light-induced S_1 to S_2 transition at 190 K or at 277 K involves a change in the oxidation state of Mn with no EXAFS-detectable change in the coordination of Mn in the O_2-evolving complex.

19391 **Theoretical considerations of a new electronically collimated gamma camera utilizing gas scintillation.** Fujieda, I.; Perez-Mendez, V. (Shimadzu Corp., Kyoto). pp 84-90 of Medical imaging. Schneider, R.H.; Dwyer, S.J. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1987). (CONF-870269—).

From Society of Photo-Optical Instrumentation Engineers' medical imaging I conference; Newport Beach, CA, USA (1 Feb 1987).

A new electronically collimated gamma camera utilizing a gas scintillation position-sensitive detector and a multiwire proportional chamber is proposed and its imaging characteristics are discussed in this paper. The scheme preserves all the advantages of an electronically collimated system (ECS) i.e. high sensitivity and simultaneous multiple views of the object over the conventional NaI gamma camera. Compared with the Ge based ECS, this scheme would have higher spatial resolution and avoid the construction difficulties of a large area Ge detector.

19392 **(CEA-CONF—8995) Nuclear magnetic resonance imaging.** Goldman, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique). Apr 1987. 19p. (CEA-DPHG-SPSRM—07; CONF-8704190—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753187/JAW.

From 7. general conference of the condensed matter; Pisa, Italy (7 Apr 1987).

Nuclear Magnetic Resonance Imaging is a non-invasive method of imaging in vivo of the concentration and relaxation times of the mobile protons in bodies. It yields morphological and sometimes physiological information on patients. After recalling the principle of NMR we describe the methodology of obtention of spatially localized signals and present examples of images of clinical interest.

19393 **(INIS-mf—11613) Radiological diagnosis of liver tumours. Evaluation of angiography and intravenous and intra-arterially enhanced computed tomography.** Lundstedt, C. (International Atomic Energy Agency, Vienna (Austria)). 27 Feb 1987. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752292/JAW.

Sixty patients treated with an intra-arterial cytostatic drug for metastases from colo-rectal carcinoma were evaluated with angiography to determine prognostic parameters. The extent of tumour in the liver and an unchanged or diminished tumour volume following treatment, as demonstrated with angiography, were associated with significant prolongation of survival. Patients who developed occlusion of the hepatic artery or of branches of the portal vein, also survived longer. 189 patients examined with angiography, 161 with computed tomography (CT), 95 with computed tomographic arteriography (CTA) and 71 with ultrasound (US) were subjected to liver evaluation at laparotomy consisting of inspection and palpation. The result of this surgical liver evaluation was for the purpose of the study regarded as completely accurate and was used to assess the accuracy of the different radiological methods. The location of tumour in the liver lobes or segments was analysed, with a separate evaluation of the right and left liver lobes. The rate of detection of individual tumour nodules was also determined. Angiography detected 55% of liver areas affected by tumour and 47% of individual tumour nodules. CT detected 83% of liver lobes or segments containing tumour, and 70% of the tumour nodules. US detected 69% of the portions of liver holding tumour, and also 69% of the tumour nodules. CTA detected 85% of tumours areas and 74% of separate tumour nodules. Some lesions detected with CT were not seen with CTA and vice versa. More false-positive results were recorded with CTA than with CT using intravenous contrast enhancement.

19394 **(INIS-SU—432, pp 126) Experience on development of automated analysis of fluorograms of chest organs.** Stranadko, E.F.; Khadzhiev, M.A.; Dzyuba, G.I.; Kuznetsov, L.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19395 (INIS-SU—432, pp 128-129) **Organization of X-ray service for early detection of lung tumors.** Tyurin, E.I.; Vikhovskij, S.P.; Zejdlits, V.N.; Lovyagin, E.V.; Nejshtadt, A.S.; Pruchanskij, V.S. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19396 (INIS-SU—432, pp 156-158) **Principles and volume of more exact diagnosis for planning of oncologic patients treatment.** Denisov, L.E. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19397 (INIS-SU—432, pp 164-167) **Nuclear diagnosis.** Pozmogov, A.I. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19398 (INIS-SU—432, pp 175) **Roentgenoendovascular surgery in treatment of patients with cancer kidney.** Anisimov, V.N.; Gershanovich, M.L.; Ryzhkov, V.K.; Gubareva, A.V.; Vinokurova, N.A.; Markochev, A.B.; Krajz, B.O.; Stukov, A.N. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19399 (INIS-SU—432, pp 176-177) **Peculiarities of diagnosis and treatment of cervix uterine carcinoma combined with pregnancy.** Vishnevskaya, E.E. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19400 (INIS-SU—432, pp 209) **Possibilities of modern methods of diagnosis and treatment of metastatic tumors to liver.** Akhmedov, B.P.; Gromov, G.B. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19401 (INIS-SU—432, pp 210) **Use of multicomponent highly contrast barium sulfate aqueous suspension in early diagnosis of tumoral and nontumoral diseases of the stomach.** Ashurova, G.A.; Alekseev, G.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19402 (INIS-SU—432, pp 220) **Reasons of diagnostic errors and the ways to eliminate them in patients with lung carcinoma at the stage of ambulant examination.** Blinov, N.N.; Keller, Yu.M.; Skiba, V.N. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19403 (INIS-SU—432, pp 225) **Feasibilities of angiographic diagnosis of carotid and vagal glomes.** Borodulin, Yu.V.; Ovsienko, A.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19404 (INIS-SU—432, pp 231-232) **Application of electroroentgenoparietography in diagnosis of stomach tumours.** Vajchyulis, S.S. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19405 (INIS-SU—432, pp 235) **Method for determining the real size of malignant tumors of mammary glands by means of computerized analysis of mammograms.** Vepkhvadze, R.Ya.; Kapanadze, B.B.; Lalashvili, K.Ya.; Vepkhvadze, D.P. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19406 (INIS-SU—432, pp 241) **Diagnosis of brain tumors by means of emission computed tomography.** Gabuniya, R.I.; Bogdasarov, Yu.B.; Zajtseva, T.I.; Zubovskij, L.G. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19407 (INIS-SU—432, pp 246-247) **Endovascular surgery of liver tumors.** Granov, A.M.; Gershanovich, M.L.; Zemlyanoj, V.A.; Borisov, A.E.; Ryshkov, V.K.; Buevich, V.A.; Shelukhin, A.P.; Levin, L.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19408 (INIS-SU—432, pp 247-248) **Combined X-ray endoscopic examinations in pancreas cancer.** Grenkov, G.I.; Kogan-Ozeran, V.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19409 (INIS-SU—432, pp 248) **X-ray endovascular catheter surgery of hemostasis of bleeding disseminated bladder cancer.** Grinval'd, V.A.; Slobodzyan, B.M.; Dmitrieva, I.A.; Shkol'nik, M.I. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19410 (INIS-SU—432, pp 248-249) **Arteriography for efficiency control of thermoradiotherapy of rectum cancer.** Grishin, G.N.; Dergachev, A.I.; Menteshashvili, G.Z. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19411 (INIS-SU—432, pp 271) **Possibilities of combined examination in differential diagnosis of pancreas cancer.** Itin, A.B.; Kuvshinov, Yu.P.; Kolesnikova, E.K.; Dolgushin, B.I.; Dzhumaliev, S.N.; Samojlenko, V.M. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19412 (INIS-SU—432, pp 271-272) **Endoscopic diagnosis of early esophagus cancer.** Kabulov, M.K.; Dzhuraeva, T.U. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19413 (INIS-SU—432, pp 347) **Nuclear magnetic resonance-spectroscopy of blood serum of patients with malignant lymphomas.** Pugachev, V.F. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19414 (INIS-SU—432, pp 353) **Lymphoductography in complex diagnosis of esophagus cancer.** Savin, A.A.; Chanyshev, Kh.A.; Karpakov, V.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19415 (INIS-SU—432, pp 357) **Retrograde endoscopic pancreaticocholangiography in differential and topical diagnosis of neoplasms of pancreatohypatoduodenal zone.** Semin, M.D.; Nechitajlo, M.E.; Ogorodnik, P.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19416 (INIS-SU—432, pp 365) **Feasibilities of complex diagnosis of primary neoplasms of uterine tubes.** Sumtsov, G.A.; Soroka, G.M. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19417 (INIS-SU—432, pp 366-367) **Comparative assessment of roentgenological and endoscopic methods of examination in revealing stomach cancer in conditions of rural region.** Tammur, R.Kh.; Khaavel', A.A.; Khaavel', Kh.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19418 (INIS-SU—432, pp 368-369) **Computerized tomography in diagnosis of oncological processes of abdomen and retroperitoneal space.** Ternovoj, S.K. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19419 (INIS-SU—432, pp 369) **Verifying diagnosis of non-organ neoplasms of small pelvis.** Ternovoj, K.S.; Knysh, I.T.; Rogozhin, V.A.; Kononenko, N.G. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19420 (INIS-SU—432, pp 372) **Computerized tomography of neoplasms of hepatopancreatoduodenal zone.** Todua, F.I.; Danilov, M.V.; Vilyavin, M.Yu.; Mirzaev, K.K. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19421 (INIS-SU—432, pp 373-374) **Modern feasibilities of differential diagnosis of bulky neoplasms of kidneys and retroperitoneal space.** Trapeznikova, M.F.; Dutov, V.V.; Abramyan, N.S.; Molchanov, G.V.; Bal'ter, S.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19422 (INIS-SU—432, pp 376-377) **Possibilities of electroroentgenography in recognition of oncourological diseases.** Tyurin, E.I.; Gasanov, T.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19423 (INIS-SU—432, pp 383-384) **Application of automized system of X-ray images analysis in lung cancer diagnosis.** Fomin, Yu.A.; Mikhajlov, V.A.; Koltovoj, A.V.; Ehnenberg, M.G.; Tsimko, A.S. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19424 (INIS-SU—432, pp 386) **One-moment percutaneous transhepatic cholangiography and relaxation duodenography in improved diagnosis of pancreatoduodenal neoplasms.** Khalikova, T.Kh.; Maksumova, Z.I.; Sharopov, S.N. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19425 (INIS-SU—432, pp 387) **On diagnosis and treatment of uterine chorioncarcinoma.** Khashimov, U.A.; Musaev, T.M.; Sharipov, R.K. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19426 (INIS-SU—432, pp 394-395) **Complex program of roentgenogical examination in order to reveal early forms of mammary gland cancer.** Chernomordikova, M.F. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19427 (INIS-SU—432, pp 289) **X-ray functional examination of patients with lung cancer.** Kondrat'ev, N.P.; Efremov, D.P. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19428 (INIS-SU—432, pp 302-303) **Possibilities roentgeno-endoscopic diagnosis for planning surgical intervention in case of infoltrative stomach neoplasms.** Lebedev, A.M.; Skotnikov, V.I.; Mirchetich, A.S.; Kulikov, E.P. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19429 (INIS-SU—432, pp 303-304) **Trends to reveal early stages of central lung cancer.** Lemekhov, V.G.; Semenov, I.I. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19430 (INIS-SU—432, pp 309) **Electroroentgenography in topometric preparation of patients with neck and head neoplasms.** Mamontov, V.V.; Yazukyavichyus, L.A.; Atkochyus, V.B.; Aleknavichyus, Eh.Eh. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19431 (INIS-SU—432, pp 311-312) **Modern feasibilities of uterus cancer diagnosis.** Mar'ina, L.A.; Mazaev, A.P. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19432 (INIS-SU—432, pp 322) **Assessment of dissemination degree of rectum neoplasm using angio-, lympho-, echography method.** Mosidze, B.A.; Musukaev, Kh.M.; Filimonov, S.I. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19433 (INIS-SU—432, pp 326) **Clinico-roentgenological diagnosis of delayed effects of malignant tumor treatment in children.** Nelyubina, L.A.; Volkova, L.D. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19434 (INIS-SU—432, pp 345) **Complex roetgeno-endoscopic examination in case large intestine tumours.** Protopopova, R.S.; Rybin, E.P.; Pravosudov, I.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19435 (INIS-SU—432, pp 346) **To the problem of improving early radiodiagnosis of large intestine neoplasms.** Pruchanskij, V.S.; Bulatov, M.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19436 (INIS-SU—432, pp 408) **Automized diagnosis and forecasting in case of mammary gland cancer.** Shumakov, A.G.; Krakhmaleva, A.P.; Babij, Ya.S. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19437 (INIS-SU—432, pp 587) **Improvement of diagnosis of soft tissue neoplasms using electroroentgenography.** Vintergal'ter, S.F.; Vishnevik, B.I. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19438 (INIS-SU—432, pp 591) **Principles and volume of improved diagnosis for planning treatment and dispensary observation.** Loskutova, G.P.; Dekster, L.I.; Shashkova, N.G. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19439 (INIS-SU—432, pp 594-595) **System of revealing, diagnosis and treatment of mammary gland cancer at early stages of development: evaluation of efficiency and trends of further improvement.** Pinkhosevich, E.G.; Moshkov, K.V.; Legkov, A.A.; Zaseev, V.K. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19440 **(PB—88-128780/XAB) Application of transition radiation to non-invasive angiography. Final report.** Piestrup, M.A. (Adelphi Technology, Woodside, CA (USA)). Aug 1985. 62p. NTIS, PC A04/MF A01.

Color illustrations reproduced in black and white.

The investigators studied the use of transition radiation from high-density foils as a method for the production of hard x rays for the non-invasive assessment of coronary artery disease in humans. The high brightness and laser-like collimation of transition radiation make it an ideal source of x rays for medical applications. Two successful experiments were performed that demonstrated feasibility of x-ray production from high-density foils. In the first experiment, ten 1-micrometer gold foils were used at the Naval Postgraduate School 105-MeV linac to generate x-rays from 10 to 35 KeV. In the second experiment, both 400- and 500-MeV electrons from the Stanford Linear Accelerator Center's (SLAC) test beamline were used to produce x rays of 20 to 60 KeV. Two foilstacks were used in the experiment: 40 foils of 8.5 micrometer stainless steel and 20 foils of 7.8-micrometer copper. Theoretical calculations, which include photon attenuation in the foil material, agree well with these data.

19441 **(PB—88-920999/XAB) FDA (Food and Drug Administration) Compliance Program Guidance Manual (FY 88). Section 4. Medical and radiological devices.** (Food and Drug Administration, Rockville, MD (USA)). 1988. 679p. (FDA/OMO—88/5D). NTIS, PC A99.

Supersedes PB—87-920999. Updates and basic manual available on subscription as PB—88-920900; Portions of this document are not fully legible.

The FDA Compliance Program Guidance Manual provides a system for issuing and filing program plans and instructions directed to Food and Drug Administration Field operations for project implementation. Section IV provides those chapters of the Compliance Program Guidance Manual which pertain to the areas of medical and radiological devices. Some of the areas of coverage include laser and sunlamp standards inspections, compliance testing of various radiation-emitting products such as television receivers and microwave ovens, emergency response planning and policy, premarket approval and device manufacturers inspections, device problem reporting, sterilization of devices, and consumer education programs on medical and radiological devices.

19442 **Extended X-ray absorption fine structure of copper in Cu/sub A/-depleted, p-(hydroxymercuri)benzoate-modified, and native cytochrome c oxidase.** Li, P.M.; Gelles, J.; Chan, S.I. (California Institute of Technology, Pasadena). *Biochemistry;* **26**: No. 8, 2091-2095(21 Apr 1987).

Cytochrome c oxidase contains four redox-active metal centers: two heme irons, cytochromes a and a_3, and two copper ions, Cu/sub A/ and Cu/sub B/. Due to the paucity of spectroscopic signatures for both copper sites in cytochrome c oxidase, the ligands and structures for these sites have remained ambiguous. The

specific depletion of Cu/sub A/ from the p-(hydroxymercuri)benzoate- (pHMB-) modified cytochrome c oxidase recently reported is herein described. Characterization of this enzyme shows that the structures of the remaining metal centers are essentially unperturbed by the Cu/sub A/ modification and depletion. Copper extended X-ray absorption fine structure (EXAFS) measurements on the Cu/sub A/-depleted cytochrome c oxidase reveal coordination of three (N, O) ligands and one (S, Cl) ligand at the Cu/sub B/ site. Comparison of EXAFS results obtained for the Cu/sub A/-depleted, pHMB-modified, and unmodified control enzymes has allowed the deconvolution of the EXAFS in terms of the inner coordination spheres for Cu/sub A/ as well as Cu/sub B/ . On the basis of these data, it is found that the structure for the Cu/sub A/ site is consistent with two (N,O) ligands and two S ligands.

19443 **On the convergence of the maximum likelihood estimator method of tomographic image reconstruction.** Llacer, J.; Veklerov, E.; Hoffman, E.J. (Lawrence Berkeley Lab., Univ. of California, Mailstop 29-100, Berkeley, CA 94720). pp 70-76 of Medical imaging. Schneider, R.H.; Dwyer, S.J. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1987). (CONF-870269—).

From Society of Photo-Optical Instrumentation Engineers' medical imaging I conference; Newport Beach, CA, USA (1 Feb 1987).

The Maximum Likelihood Estimator (MLE) method of image reconstruction has been reported to exhibit image deterioration in regions of expected uniform activity as the number of iterations increases beyond a certain point. This apparent instability raises questions as to the usefulness of a method that yields images at different stages of the reconstruction that could have different medical interpretations. In this paper the authors look in some detail into the question of convergence of MLE solutions at a large number of iterations and show that the MLE method converges towards the image that it was designed to yield, i.e, the image which has the maximum likelihood to have generated the specific projection data resulting from a measurement. They also show that the maximum likelihood image can be a very deteriorated version of the true source image and that only as the number of counts in the projection data becomes very high, will the maximum likelihood image converge towards an acceptable reconstruction.

19444 **Radiographic imaging using multilayer mirrors.** Nelson, R.S.; Zach, R.D.; Ziegler, E.; Papin, P.J.; Barbaric, Z.L.; Ricci, A.R.; Bassett, L.W. (Dept. of Radiological Sciences, UCLA Medical Center, CHS, Los Angeles, CA 90024). pp 116-123 of Medical imaging. Schneider, R.H.; Dwyer, S.J. Bellingham, WA; Society of Photo-Optical Instrumentation Engineers (1987). (CONF-870269—).

From Society of Photo-Optical Instrumentation Engineers' medical imaging I conference; Newport Beach, CA, USA (1 Feb 1987).

It is desirable to limit detected x-ray scatter and the x-ray beam bandwidth since these two factors affect image contrast or data used for material composition analysis. Substantial scatter reduction is possible if slit scan imaging techniques are utilized. A multilayer structure which is comprised of a stack of high and low atomic number materials can be used in the reflective mode to generate a narrow bandwidth slit-like x-ray beam. Theoretical reflectivity data for multilayer mirror designs which could be used for mammography, the imaging of iodinated contrast material, CT and dual energy analysis are presented. A breast phantom was imaged at 21 KeV using a ReW-C multilayer, a radiographic W-anode source and a screen-film receptor. Reflected spectra were measured with the ReW-C multilayer and a Mo anode tube. Modifications to the mirror-based imaging system and the need for an efficient detector are considered as means of reducing tube heating.

19445 **(INIS-mf—11626) Local recidivation of operated breast cancer after electron cineroentgenotherapy of the thorax wall.** Mutschler, J. (Tuebingen Univ. (Germany, F.R.). Medizinische Fakultaet). 1986. 88p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752247/JAW.

Of 354 patients undergoing radiotherapy up to 31 Dec 1982, 268 comparable cases were examined with regard to local recurrences, metastases, and general health status. The incidence of local recurrences suggested a higher efficiency of this technique as compared with the formerly applied technique of 4-field high-voltage therapy. Medial or central tumours were found to have an almost significantly loss favourable prognosis, which suggests a first spread remote metastases via the parastermal lymphatic vessels. The other 86 patients were analyzed descriptively according to subgroups. Radiolesions of the skin and lungs were not significantly less or more frequent than with other radiotherapies. Electron cineroentgenotherapy is well tolerated even by pre-exposed skin: The Tuebingen experience so far proves the acceptability of the new technique.

19446 (INIS-SU—432, pp 169-172) **Modern principles of treatment of oncologic patients.** Chissov, V.I.; Garin, A.M.; Zhakov, I.G.; Kiseleva, E.S.; Borisov, V.I. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19447 (INIS-SU—432, pp 174) **Results of radiation and combined (radiation and surgical) treatment of cancer of thoracic section of esophagus.** Amanova, S.A.; Mamontov, A.S.; Vakhapova, L.G. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19448 (INIS-SU—432, pp 193) **Seventeen years of hyperthermia usage in oncology.** Savchenko, N.E.; Zhakov, I.G.; Fradkin, S.Z.; Zhavrid, Eh.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19449 (INIS-SU—432, pp 177-178) **Clinical experience of intensive preoperative irradiation usage at malignant neoplasms of main localizations.** Goldobenko, G.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19450 (INIS-SU—432, pp 182-183) **Clinical experience of intensive preoperative irradiation at malignant tumors of main localizations.** Kanaev, S.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19451 (INIS-SU—432, pp 183-184) **Potentialities of combined treatment of cancer of thoracic section of esophagus.** Mamontov, A.S.; Kukharenko, V.M.; Zimina, E.S. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19452 (INIS-SU—432, pp 187-188) **Biochemical indices of blood serum during radiation and chemoradiation therapy planning.** Mustafina, R.Kh.; Akhmetbekova, Kh.A.; Tsoj, A.I.; Azhigaliev, N.A.; Balmukhanov, S.B. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19453 (INIS-SU—432, pp 194-196) **Modern principle of treatment of lung cancer patients.** Trakhtenberg, A.Kh.; Utkin, V.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19454 (INIS-SU—432, pp 199) **Pregnancy and rectum cancer.** Abolmasov, E.I.; Zhivetskij, A.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19455 (INIS-SU—432, pp 200) **Bremsstrahlung of betatron during combined and comprehensive treatment of esophagus cancer.** Azhigaliev, N.A.; Sadykov, S.S.; Mukhamedzhanov, K.Kh.; Bejsebaev, A.A.; Kaliev, K.T.; Musabekov, N.A.; Asanov, A.A.; Shambulov, R.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19456 (INIS-SU—432, pp 200-201) **Ultrasonics and UHF-fields in comprehensive therapy of advanced case of stomach cancer.** Azizov, I.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19457 (INIS-SU—432, pp 202-203) **Effect of immunomodular therapy on the kidneys function and immunity indices in patients with cancer of lung and rectum in the process of surgical and combined treatment.** Aleksandrin, G.P.; Evtyukhin, A.I.; Gel'fond, M.L.; Salmanova, E.A.; Shul'ga, N.I. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19458 (INIS-SU—432, pp 204-205) **Role of conservative operations in comprehensive treatment of patients with tumors of bones of shoulder girdle.** Amiraslanov, A.T.; Orlov, V.A.; Gabuniya, G.G. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19459 (INIS-SU—432, pp 205) **Combined treatment of disseminated primary and recurrent (after radiotherapy) larynx cancer.** Andreev, V.G. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19460 (INIS-SU—432, pp 208) **Use of nitrosourea derivatives in treatment of lymphogranulomatosis recurrents.** Arkhipov, A.I.; Danova, L.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19461 (INIS-SU—432, pp 209-210) **Combined therapy of rectum cancer.** Akhmetov, M.M.; Roshchektaev, N.V.; Iembergenov, A.I.; Kozhakhmetov, B.Sh.; Berdavletov, S.B. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19462 (INIS-SU—432, pp 213) **Efficiency of conservative methods of treatment of patients with tumors of stomatopharynx anterior wall.** Bazarov, N.I.; Akhmedov, B.P.; Baev, V.T.; Kadyrov, K.S. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19463 (INIS-SU—432, pp 215-216) **Comparative assessment of the results of radiation and combined treatment of cervix uteri cancer using intracavitary gamma-therapy with sources of low and high dose rates.** Baranov, S.B.; Stankevich, A.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19464 (INIS-SU—432, pp 217) **On choosing treatment method in patients with larynx neoplasm on the base of individual forecasting.** Bedrin, L.M.; Ginzburg, G.A.; Kazantsev, V.S.; Chashchin, G.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19465 (INIS-SU—432, pp 217-218) **Combined treatment of patient with stomach cancer with preoperative radio therapy in the regime of dose fractionation.** Berdov, B.A.; Mardynskij, Yu.S.; Ivanov, V.K.; Mizun, Eh.P. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19466 (INIS-SU—432, pp 219) **Use of electron-seeking compounds of metronidazole in combined treatment of patients with localized and extended forms of osteogenous sarcomas.** Bizer, V.A.; Konoplyannikov, A.G.; Grigor'ev, A.N. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19467 (INIS-SU—432, pp 221-222) **Remission fixation in combined treatment of patients with lymphogranulomatosis of 3 and 4 stage.** Bogatyreva, T.I. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19468 (INIS-SU—432, pp 223-224) **Interarterial medicinal therapy in complex treatment of locally spread of mammary gland neoplasm.** Bondar', G.V.; Tyumentsev, V.P.; Sheplyakov, M.N.; Borzenko, B.G. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19469 (INIS-SU—432, pp 226) **Assessment of treatment results in patients with mammary gland cancer in the Latvian SSR.** Bramberga, V.M.; Rozenbakha, V.P.; Vikmanis, U.Eh.; Leya, D.P.; Suvejzde, R.B.; Tseplite, R.K.; Priedite, I.Yu.; Bergmanis, A.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19470 (INIS-SU—432, pp 226-227) **Combined chemotherapy of inoperable esophagus cancer with local antitumoral injection of cytostatics.** Britsis, F.A.; Bagrin, V.G.; Bejnberg, A.A.; Purkalne, T.S. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19471 (INIS-SU—432, pp 229) **Experience of application of modified treatment methods in otorhinolaryngologic oncology.** Bykov, V.L.; Martynyuk, L.A.; Rozenfel'd, L.G.; Opanashchenko, G.A.; Bozhko, G.T.; Yarmolenko, S.P.; Mazokhin, V.N.; Iashvili, Z.G. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19472 (INIS-SU—432, pp 229-230) **Increase of efficiency of extended operations in combined treatment cervix uterine cancer.** Bykybaev, A.O. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19473 (INIS-SU—432, pp 232) **Local SHF-hyperthermia in treatment of patients with larynx cancer in vestibular section.** Vakker, A.V.; Fradkin, S.Z.; Zhavrid, Eh.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19474 (INIS-SU—432, pp 234) **Combined treatment stomach cancer of cardial section with large-fractionated telegammatherapy.** Vashakmadze, L.A.; Talaev, M.I.; Babayan, L.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19475 (INIS-SU—432, pp 238-239) **Clinical results of combined treatment of patients with cervix uterine carcinoma using preoperative intracavitary irradiation.** Vishnevskaya, E.E. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19476 (INIS-SU—432, pp 241-242) **Immediate results of comprehensive combined pneumonectomy in lung cancer.** Gagua, R.O.; Ordzhonikidze, G.K.; Chachkhiani, T.I.; Abesadze, P.I.; Kebadze, A.N. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19477 (INIS-SU—432, pp 242) **Combined treatment of malignant thymoma.** Ganul, V.L.; Ganul, A.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19478 (INIS-SU—432, pp 243) **Combined treatment of patients with cancer of esophagus and cardia with preoperative irradiation and immunotherapy.** Ganul, V.L.; Grinevich, Yu.A.; Kamenets, L.Ya.; Okulov, L.V.; Baraboj, V.A.; Orel, V.Eh.; Krakhmalev, S.N.; Nochka, V.I.; Khinzitskaya, E.F. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19479 (INIS-SU—432, pp 249-250) **State of cardiovascular system as a factor determining capacity for work of women subjected to radical treatment of mammary gland cancer.** Gundareva, I.D.; Lebedeva, N.N.; Badkhen, V.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19480 (INIS-SU—432, pp 253-254) **Comprehensive (chemoradiation and immunocorrect) therapy of patients with esophagus cancer.** Dil'man, V.M.; Baisheva, S.A.; Zhalgasbaeva, G.T.; Sysoeva, M.I.; Asanov, A.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19481 (INIS-SU—432, pp 257-259) **Possibilities of comprehensive treatment of lymphosarcoma.** Dubinin, A.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19482 (INIS-SU—432, pp 258) **Organization of medical aid to patients with larynx cancer in Buriat Autonomous Soviet Socialist Republic.** Dugarzhapov, M.O.; Krasnik, Eh.S. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19483 (INIS-SU—432, pp 258-259) **Comprehensive treatment of epidermoid lung cancer.** Dudareva, L.A.; Novikova, N.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19484 (INIS-SU—432, pp 260) **Results of combined treatment of patients with malignant tumors of colon with preoperative intensive gamma radiation.** Evtushenko, O.I.; Tofan, A.V.; Tashchiev, R.K.; Gorlushko, N.N. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19485 (INIS-SU—432, pp 264) **Radiation and chemoradiation treatment of inoperable lung cancer.** Zholkiver, K.I.; Borisevich, N.V.; Mukhambetova, G.A.; Akyshbaev, A.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19486 (INIS-SU—432, pp 268) **On the problem of treatment of tumoral patients with compression mediastinal syndrome.** Zmeul, V.K.; Kustov, V.I.; Ponomarenko, S.P.; Kindyalov, V.M. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19487 (INIS-SU—432, pp 272-273) **Clinical evaluation of results of comprehensive (chemoradiation) treatment of 1-3A, B stage lymphogranulomatosis.** Kanaev, S.V.; Malinin, A.P.; Danova, L.A.; Kholin, A.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19488 (INIS-SU—432, pp 273-274) **Decreasing suppurative bronchopleural complications during surgical and combined treatment of lung cancer.** Kapatsinskij, E.V.; Popov, M.I. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19489 (INIS-SU—432, pp 358-359) **Actual problems of treating locally disseminated rectal tumours.** Simonov, N.N.; Musukaev, Kh.M.; Gulyaev, A.V.; Korkhov, V.V.; Mosidze, B.A.; Matveev, B.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19490 (INIS-SU—432, pp 360-361) **Subtotal irradiation in program treatment of patients with Hodgkin's disease.** Simbirtseva, L.P.; Shust, V.F.; Vinogradov, V.M. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19491 (INIS-SU—432, pp 362-363) **Combined treatment of patients of uterine cervix carcinoma using Cf/sup 252/ sources of high activity for preoperational intracavitary irradiation.** Spasokukotskaya, O.N.; Lebedev, A.I.; Chekhonadskij, V.N.; Merkle, K. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19492 (INIS-SU—432, pp 364) **Problems of rehabilitation of patients with lung and larynx cancer after radiotherapeutic methods.** Strashinin, A.I.; Gerasimyak, V.G.; Vladimirova, V.A.; Ivanova, L.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19493 (INIS-SU—432, pp 365-366) **Complex treatment of neoplasms of external genitals.** Tadzhibaeva, Yu.T. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19494 (INIS-SU—432, pp 366) **Early results of combined treatment of stomach cancer.** Talaev, M.I.; Starinskij, V.V.; Kovalev, B.N.; Sidorova, E.A.; Kremlev, V.V.; Laletin, V.G.; Tret'yakov, I.V.; Mavrodi, V.M. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19495 (INIS-SU—432, pp 369-370) **Combined treatment of Ewing's sarcoma.** Timukhina, V.N. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19496 (INIS-SU—432, pp 371) **Retrospective analysis of 5-year survival of patients with esophagus neoplasms of chest section in case of radiation, surgical and combined treatment.** Tikhonova, N.A.; Klimanova, N.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19497 (INIS-SU—432, pp 374) **Trends to improve treatment methods of patients with malignant tumours of soft tissues.** Trishkin, V.A.; Stolyarov, V.I.; Frolova, Z.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19498 (INIS-SU—432, pp 374-375) **Combined treatment of radioresistant neoplasm recurrences of maxillo-facial localization using chemotherapy and cryodestruction.** Trushkevich, L.I. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19499 (INIS-SU—432, pp 381) **Results of radiation component of complex therapy of patients with lymphogranulomatosis of 3 stage.** Filatova, A.M.; Simbirtseva, L.P.; Vinogradov, V.M. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19500 (INIS-SU—432, pp 382-383) **Possibilities of echotomography in planning radiation treatment of prostate cancer.** Filippenko, V.I.; Abdrakhmanov, Zh.N.; Minakova, L.R.; Kobikova, Zh.Kh. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19501 (INIS-SU—432, pp 388) **Electromagnetic local hyperthermia in combination with radio- and drug therapy in treating patients with osteogenous sarcoma.** Khmelevskaya, Z.I.; Bojko, I.N. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19502 (INIS-SU—432, pp 389) **On the effect of adjuvant hormonotherapy on the results of radiation treatment of patients with uterus cancer.** Kholin, V.V.; Stolyarova, I.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19503 (INIS-SU—432, pp 390) **Local hyperthermia in combined treatment of malignant tumours in children.** Tsejtlin, G.Ya.; Myshanova, N.M. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19504 (INIS-SU—432, pp 393-394) **Results of first phase of clinical approbation of fast neutron beam of Kiev cyclotron U-120 of Institute of Nuclear Research of Ukrainian Academy of sciences in treating oncological patients.** Chernichenko, V.A.; Nikishin, B.K.; Tolstopyatov, B.A.; Demina, Eh.A.; Bezdrobnaya, L.K.; Protsyk, V.S.; Sycheva, T.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19505 (INIS-SU—432, pp 395) **Experience of radical operation on case of pancreas and duodenal papilla cancer with intensive preoperative irradiation.** Chernyj, V.A.; Smolanka, I.I.; Shvannskaya, N.L. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19506 (INIS-SU—432, pp 274-275) **Nonuniform irradiation of locally dissimenated soft tissues sarcomas in the plan of combined treatment.** Karapetyan, R.M.; Yur'eva, T.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19507 (INIS-SU—432, pp 275) **Delayed results of conservative treatment of locally disseminated stomach cancer.** Karosene, Eh. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19508 (INIS-SU—432, pp 277-278) **Indometacin in inoperable patients with lung cancer.** Kas'yanenko, I.V.; Erusalimskij, E.L.; Pivnyuk, V.M.; Semenchuk, D.D. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19509 (INIS-SU—432, pp 279-280) **Indications to postoperative irradiation in patients with 1B stage (pT/sub 1/N/sub 0/M/sub 0/) cervix uterine carcinoma.** Kashina, N.O.; Gastev, A.Yu.; Baranov, S.B. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19510 (INIS-SU—432, pp 280) **Methods of improving the treatment of rectum cancer.** Kikot', V.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19511 (INIS-SU—432, pp 284-285) **Use of magnetic field in reductive treatment of patients with breast cancer.** Kozlov, S.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19512 (INIS-SU—432, pp 287) **Increase in efficiency of radiotherapy of some localizations of malignant tumors using additional immunochemotherapy.** Kolesnikova, V.A.; Rozenko, L.Ya.; Rubtsov, V.R.; Vagner, V.P.; Brazhnikova, E.I. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19513 (INIS-SU—432, pp 287-288) **Comprehensive treatment of lymphogranulomatosis in children.** Kolygin, B.A.; Malinin, A.P. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19514 (INIS-SU—432, pp 291) **Results and prospects of combined treatment of rectum cancer.** Korkhov, V.V.; Frolova, Z.V.; Akimov, A.A.; Savel'eva, O.P. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19515 (INIS-SU—432, pp 291-292) **Trends increasing efficiency of treatment of Hodgkin's disease.** Korytova, L.I. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19516 (INIS-SU—432, pp 292) **Assessment of combined and complex treatment of patients with bone sarcomas.** Kosaev, A.K.; Pozdnukhov, L.G. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19517 (INIS-SU—432, pp 293) **Combined treatment of stomach cancer using hypoxyradiotherapy.** Kosseh, V.A.; Khvorostenko, M.I.; Aslyaev, L.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19518 (INIS-SU—432, pp 294-295) **Principles of combined treatment of rectum cancer.** Koshchug, S.D.; Kolod'ko, V.V.; Novikova, N.V.; Klechkov, G.N. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19519 (INIS-SU—432, pp 295-296) **Combined treatment of skin malignant melanomas.** Kudryavtseva, G.T.; Khmelevskaya, Z.I.; Ilyukhin, S.A.; Neborak, Yu.T. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19520 (INIS-SU—432, pp 297) **Ultrasonics and UHF-field in complex treatment of locally-spread of soft tissue sarcomas and mammary gland neoplasms.** Kuznetsov, V.N.; Khodzhaev, A.V.; Makhmudov, S.F. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19521 (INIS-SU—432, pp 304-305) **Application of nonsteriod antiinflammatory preparations in combination with preoperative chemotherapy in patients with locally-disseminated mammary gland cancer (preliminary results of randominized study).** Letyagin, V.P.; Chikvashvili, B.Sh.; Polevaya, E.B.; Ermilova, V.D. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19522 (INIS-SU—432, pp 305-306) **Polychemo-radiation treatment of localized forms of planocellular lung cancer.** Linchenko, I.F.; Danil'yan, V.M. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19523 (INIS-SU—432, pp 306-307) **Clinico-morphological substantiation of efficiency of some combined treatment methods of kidney neoplasms.** Mavrichev, A.S.; Makarevich, S.A.; Murav'ev, G.N.; Dudarev, V.S. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19524 (INIS-SU—432, pp 307-308) **Intensive gamma-therapy in combination with local SHF-hyperthermia before radical operation in case of stomach cancer.** Maligonov, P.A.; Rudakov, N.P.; Korobko, V.B.; Bojko, G.S.; Udatova, T.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19525 (INIS-SU—432, pp 308) **On methods of short-focus roetgenotherapy of skin hemangiomas in children.** Malikov, A.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19526 (INIS-SU—432, pp 314-315) **Ultrasonics in complex treatment of female genital neoplasms.** Makhmudova, M.M. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19527 (INIS-SU—432, pp 317-318) **Combined treatment of patients with locally-disseminated rectum neoplasm.** Miloslavskij, I.M. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19528 (INIS-SU—432, pp 320) **Irradiation of brain metastases in complex treatment of patients with malignant tumours.** Mikhina, Z.P.; Motorina, L.I.; Vojnarevich, A.O. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19529 (INIS-SU—432, pp 321-322) **Radiotheraphy and chemoradiotherapy of neglected pharynx neoplasms.** Morozov, A.I.; Rogachikova, T.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19530 (INIS-SU—432, pp 323) **Treatment of patients with malignant tumor metastases in peripheral lymph nodes and recurrences.** Mus, V.F.; Parfenov, A.A.; Mikhajlov, O.L.; Khazova, T.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19531 (INIS-SU—432, pp 325-326) **On combined treatment of rectum neoplasm.** Nadzharov, A.G.; Abdullaeva, Eh.D.; Sultanov, I.B.; Mamedov, K.T.; Mamed"yarov, Yu.M.; Ali-zade, A.M. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19532 (INIS-SU—432, pp 330) **Computers in planning radiotheraphy using computerized tomographic data.** Pavlov, A.S.; Gorlachev, G.E.; Ermolaeva, E.V.; Ternovoj, S.K.; Burov, S.B. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19533 (INIS-SU—432, pp 331-332) **Role of enlarged regime of preoperational irradiation in increasing efficiency of treatment of patients with mammary gland neoplasms.** Pantyushenko, T.A.; Muravskaya, G.V.; Milevskaya, T.G. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19534 (INIS-SU—432, pp 336-337) **Modern approach to surgical and combined treatment of lung cancer.** Pirogov, A.I.; Goldobenko, G.V.; Abramov, V.F.; Laktionov, K.P.; Polotskij, B.E.; Shchebetenko, Yu.E. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19535 (INIS-SU—432, pp 337) **Surgical and combined treatment of esophagus cancer.** Pirogov, A.I.; Davydov, M.I.; Ryndin, V.D. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19536 (INIS-SU—432, pp 345-346) **Combined treatment of malignant tumours of the upper jaw.** Protsyk, V.S. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19537 (INIS-SU—432, pp 346-347) **Preoperative polychemotherapy in complex treatment of larynx neoplasm.** Prushinskas, Yu.Yu. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19538 (INIS-SU—432, pp 398-399) **Efficiency of complex treating lymphogranulomatosis in children.** Chikvashvili, A.M.; Shanidze, G.S.; Zukhbaya, T.L.; Tabatadze, N.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19539 (INIS-SU—432, pp 399) **Results of combined treatment of lung cancer in case of extended operations.** Chirvina, E.D.; Kartashov, S.Z.; Chilingaryants, S.G. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19540 (INIS-SU—432, pp 399-400) **Results of combined chemoradiation treatment of patients with esophagus cancer.** Chichua, N.A.; Tsoj, A.I.; Dyusembaev, Z.E.; Monakhov, B.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19541 (INIS-SU—432, pp 402) **Concomitant radiotherapy of neoplasms of oral cavity organs with sources of increased dose rates.** Chuprik-Malinovskaya, T.P.; Alekseeva, S.I. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19542 (INIS-SU—432, pp 403) **Functional oncolaryngosurgery in disseminated malignant tumours of larynx.** Shanturov, A.G.; Dvornichenko, V.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19543 (INIS-SU—432, pp 414) **Experience of combined treatment of lung epidermoid cancr.** Yas'kevich, L.S.; Golibovich, I.A.; Gavril'chik, A.I.; Zharkov, V.V.; Davidovskij, I.V.; Shakuro, L.I.; Ositrova, L.I. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19544 (INIS-SU—432, pp 414) **Hyperthermia in complex treatment of malignant tumours.** Yakhontov, N.E.; Pugachov, V.F.; Terent'ev, N.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19545 (INIS-SU—432, pp 416) **Twenty years experience of radiation and combined treatment of stomach cancer.** Yashinskas, P.K.; Ragajshene, V.N. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19546 (INIS-SU—432, pp 506) **On production of immune interferon in patients with mammary gland and cervix uteri cancer.** Gevorkyan, R.A.; Movsesyan, Eh.A.; Gavparyan, M.G.; Kamalyan, L.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19547 (INIS-SU—432, pp 586) **Role of afteroperative irradiation in combined treatment of lung cancer.** Vagner, R.I.; Barchuk, A.S.; Velibekov, V.S.; Bajkova, V.S. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19548 (INIS-SU—432, pp 594) **Saving operations in case of larynx cancer after various variants of preoperational radiation course.** Ol'shanskij, V.O.; Kiseleva, E.S.; Bityutskij, P.G.; Dar'yalova, S.L. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19549 **Physical characteristics of 670A MeV /sup 20/Ne at its Bragg peak.** Schimmerling, W.; Wong, M.; Rapkin, M.; Howard, J.; Murphy, D. (Lawrence Berkeley Lab., Berkeley, CA). pp 99 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

The dose delivered to a patient in heavy ion radiotherapy is dependent not only on the properties of the primary beam, but also on the properties of its secondary fragment distribution. Measurements are presented for several points on the unmodified Bragg peak of 670 A MeV /sup 20/Ne giving the charge and velocity distributions of the beam components. The experiments were performed at LBL's Bevalac Bio-Medical Facility using a time-of-flight particle identification spectrometer. The authors will present for a high statistics run the derived LET spectra for each fragment. Once corrections for backgrounds and acceptance have been made to the data, then the experimental measurements of the fluence, charge, and velocity of beam components constitutes a complete characterization of this point on the Bragg curve. The interpretation of radiobiological experiments at this point can then be made in terms of models of the direct biological action of radiation rather than in the more primitive terms of averaged quantities.

19550 **(INIS-BR—920) Dose determination in breast tumor in brachytherapy using Iridium-192.** Okuno, S.F. (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1984. 122p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number TI88701461/JAW.

Thermoluminescent dosimetry studies in vivo and in vitro aiming to determing radiation dose in the breast tumor, in brachytherapy using Iridium-192 was done. The correlation between

radiation doses in tumor and external surface of the breast was investigated for correcting the time interval of radiation source implantation.

19551 (INIS-SU—432, pp 257) **Radioactive iodine in treatment of 4 stage thyroid cancer.** Drozdovskij, B.Ya.; Proshin, V.V. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

5507 Microbiology

REFER ALSO TO CITATION(S) 17517, 17521, 17679, 17901, 17902, 19335, 19553, 19596

19552 **(AD-A—186328/1/XAB) Detection and quantitation of t-2 mycotoxin in rat organs by radioimmunoassay.** Hewetson, J.F.; Pace, J.G.; Beheler, J.E. (Army Medical Research Inst. of Infectious Diseases, Fort Detrick, MD (USA)). 1987. 4p. NTIS, PC A02/MF A01.

Pub. in Jnl. of the Association of Official Analytical Chemists, Vol. 70, No. 4, 654-657(1987); Supersedes AD-A167 979.

A standard radioimmunoassay was compared with radiochromatography for the ability to detect unlabeled T-2 mycotoxin in organs from exposed animals. When 10% of HT-2, the only known metabolite that cross-reacts with T-2, was included and expressed as T-2 equivalents in the radiochromatographic detection, correlation between toxin detection in liver, spleen, and kidney by the 2 techniques was r = 0.98. An unknown metabolite was detected in heart extract by radiochromatography. Inclusion of this material in the T-2 equivalents detected by radiochromatography indicated a near-perfect correlation among all 4 tissues.

5508 Morphology

REFER ALSO TO CITATION(S) 19370

5509 Pathology

REFER ALSO TO CITATION(S) 18361, 19558, 19663

19553 **(LA-UR—88-125) A national HIV [Human Immunodeficiency Virus] database that facilitates data sharing.** Layne, S.P.; Marr, T.G.; Stanley, E.A.; Hyman, J.M.; Colgate, S.A. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 13p. (CONF-880344—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005384/JAW.

From National Academy of Science conference; Washington, DC, USA (28 Mar 1988).

The purpose of this communication is to stimulate discussion on a National Human Immunodeficiency Virus (HIV) Database that facilitates and coordinates data sharing. We argue for the creation of a new database because significant gaps exists in the type of information that are available on HIV. Databases that extensively survey the published literature on HIV are widely available, however, databases that contain either raw data or that describe ongoing HIV research efforts are not widely available. For epidemiologists, sociologists and mathematical modelers, who need to draw on raw epidemiologic and behavior data from a broad range of fields, the existing databases are inadequate. In this paper we emphasize the particular requirements of epidemiologists, sociologists and modelers, and suggest a plan to accommodate their database needs.

19554 **(PB—88-124730/XAB) Gene-Tox Carcinogen Data Base: construction, description, and analysis.** Nesnow, S.; Bergman, H. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Oct 1987. 25p. (EPA—600/D-87/323). NTIS, PC A03/MF A01.

The Gene-Tox Carcinogen Data Base is an evaluated source of cancer data on 506 chemicals selected in part for their previous assessment in genetic toxicology bioassays. Chemicals in the data base have been assessed for species-specific carcinogenic effects, and these results indicate that for mice and rats there is a high correspondence (85%). When chemicals in the Gene-Tox Carcinogen Data Base were examined for their previous evaluation in 73 genetic toxicology bioassays, only 26 of these bioassays had 30 or more chemicals. In these 26 bioassays, the prevalence of positive chemicals was generally greater than 80-90%. This suggests that a thorough evaluation of genetic toxicology bioassays in regard to their ability to predict carcinogenic effects in animals is premature at this time.

19555 **(PB—88-130117/XAB) Health and environmental effects profile for carbofuran.** (Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment). Jan 1984. 60p. (EPA—600/X-84/150). NTIS, PC A04/MF A01.

See also PB—88-130125.

The Health and Environmental Effects Profile for carbofurans was prepared by the Office of Health and Environmental Assessment, Environmental Criteria and Assessment Office, Cincinnati, OH for the Office of Solid Waste to support listings of hazardous constituents of a wide range of waste streams under Section 3001 of the Resource Conservation and Recovery Act (RCRA). Both published literature and information obtained from Agency program office files were evaluated as they pertained to potential human health, aquatic life and environmental effects of hazardous waste constituents. Quantitative estimates are presented, provided sufficient data are available. Existing data are insufficient to determine an Acceptable Daily Intake (ADI) or a carcinogenic potency factor for carbofurans.

5520 Public Health

REFER ALSO TO CITATION(S) 19124, 19139, 19140, 19141, 19142, 19143, 19144, 19145, 19146, 19147, 19148, 19149, 19150, 19151, 19152, 19153, 19154, 19155, 19156, 19158, 19159, 19160, 19248, 19249, 19250, 19251, 19252, 19253, 19254, 19255, 19256, 19257, 19259, 19265

19556 **(PB—88-125968/XAB) NIOSH (National Institute for Occupational Safety and Health) testimony on OSHA (Occupational Safety and Health Administration) proposed standard for occupational exposures to toxic substances in laboratories by L. Mazzuckelli, March 24, 1987.** (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 24 Mar 1987. 6p. NTIS, PC A02/MF A01.

Testimony was presented in support of and to expand the proposed OSHA standard for exposure to toxic materials during the course of working in a laboratory. The inclusion of a medical-surveillance provision which would require new laboratory workers to have a medical examination and would also require periodic examinations during the course of employment was urged. An effective monitoring program was also requested since, as the proposal now stands, the employee is faced with the burden of proof that an overexposure has occurred. The suggestion included the collection and analysis of air and other appropriate samples to be taken so that objective measures of the effect of efforts taken to protect workers may be made. It was recommended that a chemical hygiene officer work with the companies in establishing a standard and determining an effective monitoring program. Further, it was recommended that when there is no OSHA standard or permissible exposure limit for a substance, the program adopt the NIOSH recommended exposure limits as opposed to the limit values of the American Conference of Governmental Industrial Hygienists. Finally, employers were urged to furnish information to laboratory workers concerning the toxicity and safety hazards of the materials with which they will be working.

19557 **(PB—88-125976/XAB) Health-hazard evaluation report HETA 87-142-1802, C. F. and I. Steel Corporation, Pueblo, Colorado.** Gunter, B.J. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1987. 10p. (HETA—87-142-1802). NTIS, PC A02/MF A01.

At the request of the management of C. F. and I. Steel Corporation, an evaluation was made of worker exposure to 1,1,1-trich-

loroethane in two large vapor degreasers in the factory. The particular machine from which the vapors appeared to come was used to chop coils of galvanized wire into nails of various sizes and lengths. After the nails were chopped, they were passed through a vapor degreaser using a conveyor, packed and readied for shipping. Fifteen area samples were collected, six of which were breathing-zone air samples ranging from 41 to 399 mg/cu m. None of the breathing zone samples exceeded the OSHA and NIOSH evaluation criteria of 1900mg/cu m although the levels were higher when the degreaser was in operation. General air samples ranged from 70 to 2218 mg/cu m. None of the workers had any medical problems which they felt were associated with their jobs. The author recommends that respiratory protection be provided if workers are working for extended time periods on top of the vapor degreasers. No one should be allowed to eat, drink or smoke in the work areas. The toxicology of 1,1,1-trichloroethane should be explained to the workers.

19558 **(PB—88-125992/XAB) Dioxin Registry Report: report prepared by review of documents received from Syntex (USA), Incorporated, Verona, Missouri and site visits, September 30-October 1, 1980; June 24, 1986.** Marlow, D.; Fingerhut, M.; Hearn, S.; Jones, J.; Honchar, P. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). May 1987. 30p. (IWS—117.11). NTIS, PC A03/MF A01.

Information and documents were reviewed which had been received from Syntex Agribusiness, for a facility in Verona, Missouri operated by Hoffman-Taff and the North Eastern Pharmaceutical and Chemical Company (NEPACCO), as part of the Dioxin Registry study. During this time period Hoffman-Taff produced 2,4,5-trichlorophenoxyacetic-acid-butyl-ester and NEPACCO produced hexachlorophene. Company records located at the Syntex facility in Springfield, Missouri made it possible to identify production workers and supervisors who were involved in making these compounds. Maintenance workers were also identified. These individuals have therefore been included in the Dioxin Registry. Compensation records for workers were obtained for the period 1968 to 1972 and all medical records were obtained for employees engaged in making these particular chemicals. In analyzing Agent-Orange prepared by Hoffman-Taff, it was found to contain less than 1.0 part per million 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). Analysis of samples of NEPACCO's purified 2,4,5-trichlorophenol and hexachlorophene indicated that they contained 67 parts per billion and less than 20 parts per billion TCDD, respectively.

19559 **(PB—88-126123/XAB) Industrial-hygiene survey report, worker exposures during sugar cane harvesting, Florida Sugar Cane League, Clewiston, Florida.** Boeniger, M. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Dec 1986. 28p. (IWS—092.5.5). NTIS, PC A03/MF A01.

Literature dealing with commercially important plant species that contain amorphous silica was reviewed. Specifically, results were presented of a field survey of sugar cane field workers in Florida. Determinations were made of the airborne concentration of amorphous silica fibers to which these workers were exposed. The airborne fibers ranged in size from 3.5 to 65 micrometers long with an average diameter of 0.6 micrometers. The concentration of these fibers in the air was as high as 300,000 fibers per cubic meter during cane-cutting activities. Polyaromatic hydrocarbon concentrations were detected in the burnt leaf, but the concentrations in air were well below the limit of detection. The author recommends that comprehensive monitoring be considered for exposure to biogenic fibers among field workers, as well as refinery workers. The author also suggests that exposure to biogenic silicates in other industries which involve processing of agricultural commodities should be investigated. Solubility and persistence of these particular fibers in biological fluids should be considered.

19560 **(PB—88-128327/XAB) Health-hazard evaluation report HETA 86-073-1804, South Campbell County Middle School, Alexandria, Kentucky.** Cantor, F.L.; Lee, S.A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). Jun 1987. 24p. (HETA—86-073-1804). NTIS, PC A03/MF A01.

An evaluation was carried out at the South Campbell County Middle School, in Alexandria, Kentucky to determine possible exposures to stagnant water, excessive mold growth, and imbalances in the ventilation system. Inside the school the relative humidity levels in December ranged from 28 to 32%. Levels of carbon dioxide were determined to be 1500 parts per million, four to six times higher than outdoor levels. Water had seeped under the gymnasium floor, causing cracks in the interior and exterior walls. Problems were identified with the ventilation including poor maintenance, improperly set controls, and improper design. Results of medical questionnaires indicated that the staff at this school was three times as likely to develop respiratory symptoms as the staff at a nearby school. A significant association was found between any exposure to the library lasting at least 1 hour per week, and the development of respiratory illness.

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 17993, 17994, 18381, 19111, 20736

19561 **(IA—1427, pp 144) Electroadsorption of bacteria on porous carbon and graphite electrodes.** Golub, D.; Ben-Hur, E.; Oren, Y.; Soffer, A. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19562 **(AD-A—185935/4/XAB) Review of the quality and safety of irradiated food. Master's thesis.** Cox, J.H. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). 1987. 51p. (AFIT/CI/NR—87-107T). NTIS, PC A04/MF A01.

This monograph will describe the food-irradiation process and summarizing its historical development as a way to prolong the shelf-life of food and prevent the spread of food-borne illness. It will also examine of the known effects of irradiation on food quality. Including a presentation of the effect of irradiation on the flavor, appearance, and smell of food. The nutritional adequacy of irradiated foods and several improvements in some foods caused by irradiation are also discussed. Finally, a discussion of the safety issues associated with the process and its products. The safety of irradiated foods is an issue of growing concern to the American public. While irradiation shows great potential for reducing food-borne illness, the formation of radiolytic products, the physical dangers of radiation, and the possibility of cancer or genetic mutation worries many people.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 18816, 19621

19563 **(PB—88-140801/XAB) Suggested state regulations for control of radiation. Volume 1. Ionizing radiation (interim revision).** (Food and Drug Administration, Rockville, MD (USA). Center for Devices and Radiological Health). Jun 1987. 91p. (HHS/PUB/FDA—83-8203-REV). NTIS, PC A05/MF A01.

See also PB—83-252569.

The interim revision if Volume I includes amendments to Part C (Licensing of Radioactive Material), Part D (Standards for Protection Against Radiation), Part F (X Rays in the Healing Arts), and Part G (Use of Sealed Radioactive Sources in the Healing Arts); and a complete new Part M (Licensing Requirements for Land Disposal of Radioactive Waste). The main purpose of the interim revision is to provide companion regulations consistent and in conformity with certain amendments to Federal standards in 10 CFR Part 20, Part 35, and Part 61 and in 21 CFR Part 1020.

19564 **A probabilistic approach to relate microdosimetry, biological effects, and radiation quality.** Morstin, K.; Bond, V.P.; Varma, M.N.; Baum, J.W. (Brookhaven National Lab., Upton, NY 11973). pp 32 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—). Contract AC02-76CH00016.

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

Microdosimetry-based cellular response functions are derived from dose-effect relations for different biological endpoints, including those relevant for radiological protection. For this purpose, a probabilistic approach is being applied that makes use of measurable microdosimetric spectra and avoids controversial assumptions concerning principal mechanisms of radiation action. Instead, statistical distributions are applied and their parameters evaluated in order to characterize the sensitive target structures within cells. Resulting functions can be used for predictions of both low- and high-dose radiation effects, including those of ultra-soft x rays, and thus may be useful for on-going revisions of radiation quality specifications. They can also be directly applied in radiation-protection metrology by incorporating them into the software used to process the readings of microdosimetric spectrometers. Results of the analyses are compared with experimental data not used in fitting parameters, and with predictions from other phenomenological or "mechanistic" approaches.

19565 **A Markov formulation of the LPL model for x rays at high (conventional) dose rates.** Curtis, S.B.; Albright, N.W. (Lawrence Berkeley Lab., Berkeley, CA 94720). pp 33 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

The lethal potentially lethal (LPL) model of cell survival for X rays at conventional dose rates has been formulated accounting for a stepwise (Markov) repair of the potentially lethal lesions in individual cells. This treatment eliminates having to assume a Poisson distribution of lesions among the cells after a given repair time as was done in the original formulation. The present formulation follows earlier work of a similar nature for the RMR model. Here the survival expression is defined. S(t, D) = e/sup -eta/sub L/D/ Σ/sub κ=0//sup ∞/ P(0,t vertical bar κ,0) P/sub p/ (κ;eta/sub PL//sup D/) where P(0,t vertical bar κ,0) is the probability that an individual cell has no potentially lethal lesions at time t given κ lesions initially in the cell (at t=0): P/sub p/(κ;eta/sub PL/D) is the Poisson distribution of initial lesions with mean number eta/sub PL/ D in the cell population. The function P(O,t vertical bar κ,0) can be expressed as a series of exponential terms involving t. Comparison of this formulation with the previous one are made and differences are discussed.

19566 **WR1065 protection against radiation-induced mutations at the HGPRT locus in V79 cells.** Nagy, B.; Grdina, D.; Hill, C.; Dale, P. (Argonne National Lab., Argonne, IL). pp 98 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—). Contract W-31-109-ENG-38.

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

WR1065 protects against radiation-induced cell killing and mutagenesis at the hypoxanthine-guanine phosphoribosyl transferase (HGPRT) locus in V79 Chinese hamster lung fibroblast cells. At a concentration of 4 mM, WR1065 effectively protected against cell death only if present during irradiation, e.g., a dose modification factor (DMF) of 1.9. No protective effect was observed if WR1065 was added within 5 min after irradiation or 3 h later, e.g., DMFs of 1.0 and 1.1, respectively. In contrast, WR1065 effectively reduced radiation-induced mutations regardless of when it was administered. Following a dose of 1000 rad of /sup 60/Co γ rays, the mutation frequencies observed per 10/sup 6/ survivors were 77+-8, 27+-6, 42+-7, and 42+-7 for radiation only, and WR1065 present during, immediately after, or 3 h after irradiation. These data suggest that although a segment of radiation induced damage leading to reproductive death cannot be modulated through the postirradiation action of WR1065, processes leading to the fixation of gross genetic damage and mutation induction in surviving cells can be effectively altered and interfered with leading to a marked reduction in mutation frequency.

19567 **Wobbler facility for biomedical experiments at Bevalac.** Chu, W.T.; Curtis, S.B.; Llacer, J.; McEvoy, M.B.; Nyman, M.A.; Renner, T.R.; Singh, R.P.; Stradtner, R. (Lawrence Berkeley Lab., Berkeley, CA). pp 100 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—). Contract AC03-76SF00098.

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

A new method has been developed to deliver large uniform fields of accelerated heavy ions without resorting to the use of scattering material in the beam. The charged particle beam is made to sweep, painting a circle at the target, by a pair of dipole magnets placed in tandem with their field axes pointing orthogonally and powered sinusoidally but 90 degrees out of phase from each other. By superimposing several circles of appropriate diameters and intensities, large (up to 30 cm in diameter for 670 MeV/nucleon ions), uniform (+-2% in intensity) fields are delivered. A secondary emission monitor, three multielement ionization chambers, and two dual-plane multiwire chambers monitor the delivered dose and dose uniformity at the target. New ridge filters are developed to spread Bragg peaks of wobbled beams. Measurements of the beam quality, i.e., dose-averaged and track-average LET, have been made with a thin silicon dE/dx counter and thick germanium solid state detector telescope (BERKLET) at various positions in the wobbled beams. The wobbler system is used for biomedical experiments from the beginning of 1985.

19568 (DOE/ER/60282—3, pp 9, Paper 3) **Solid-state radiation chemistry of the DNA backbone.** Bernhard, W.A. [1987]. NTIS, PC A02/MF A01. Order Number DE88005907/JAW. Contract FG02-85ER60282.

In [Studies of radiation and chemical toxicity: Final report].

Free radical damage produced in the sugar-phosphate moiety of deoxynucleotides and deoxynucleosides exposed to ionizing radiation in the crystalline state, include monosaccharides were studied. A specific class of monosaccharide, the methyl pyranosides, is proving invaluable to working out the free radical chemistry of the sugar moiety. 3 refs., 6 figs.

19569 (IA—1427, pp 159-161) **Improved radioprotection by enhancement of DNA repair capacity as a modality radiotherapy.** Riklis, E.; Green, M.; Prager, A.; Kol, R. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19570 (IA—1427, pp 162-163) **Recovery of prostacylin production capacity of irradiated endothelial cells and the protective effect of vitamin C.** Eldor, A.; Vlodavsky, I.; Riklis, E.; Fuks, Z. (Hebrew Univ., Jerusalem, Israel. Hadassah Medical School; Israel Atomic Energy Commission, Tel Aviv; Sloan-Kettering Inst. for Cancer Research, New York, USA). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19571 (INCT—1979/10/B/B) **Damage of DNA and plasma membranes in murine lymphoma cells irradiated under aerobic or hypoxic conditions.** Wlodek, D. (Institute of Nuclear Chemistry and Technology, Warsaw (Poland)). 1983. 81p. (In Polish). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88701309/JAW.

Received in Dec 1987.

A review of the knowledge of radiation effects on cell membranes and DNA and of repair mechanisms of radiation lesions is given. Investigations of properties of plasma membranes in L5178Y-S and L5178Y-R cells (surface charge, fluidity, transport of amino acids) indicate that there is no direct connection between mem-

brane lesions and reproductive death. It was also found that in irradiated cells of both L5178Y-strains the rate of DNA chain elongation is the same, similarly as the amount of the initial DNA lesions and the rate of repair processes. Difference in the level of DNA synthesis inhibition is not proportional to the lethal effect. The results are also reported point to the difference between L5178Y-S and L5178Y-R cells in susceptibility of post-irradiation DNA synthesis to factors modifying chromatin conformation, such as inhibitors of (ADP-ribose)/sub n/ polymerase. 221 refs.

19572 **(INIS-SU—432, pp 559-560) Cloning of cultured strain cells of rat lymphosarcomas.** Sirota, N.S.; Samojlovich, M.P.; Denisova, G.N.; Klimovich, V.B. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19573 **(JINR-R—19-87-359) Amount of sister chromatid exchanges and survival of Chinese hamster V79-4 cells after irradiation with 0,7 MeV neutrons.** Lapidus, I.L.; Nasonova, E.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 4p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701511/JAW.

Submitted to the jouranl Radiobiology.

The dependence of the survival and induction of sister chromatid exchanges (SCEs) in Chinese hamster V79-4 cells on the dose of γ-rays and neutrons with average energy 0.7 MeV has been analysed. The value of RBE for neutrons was 5.5. It has been shown that the number of SCE increased with the dose of γ-irradiation and no induction could be detected after neutron irradiation. 12 refs.; 2 figs.

19574 **(KURRI-TR—295) Proceedings of the symposium on role of oxygen in biological actions of radiation.** Ikushima, Takaji (ed.). (Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst.). 1987. 73p. (In English and Japanese). (CONF-8701108—). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88900376/JAW.

From Symposium on the role of oxygen in biological actions of radiation; Kyoto, Japan (23 Jan 1987).

The presence of molecular oxygen is sensitizing for almost all effects of ionizing radiation on living cells, like the induction of lethality, gene mutations, chromosomal aberrations, life shortening or cancer. It is currently believed that the radiosensitizing action of oxygen may be mediated through reactive oxygen species generated by radical reactions of radiolysis products of water. Recently, active oxygen has been reported to play important roles in carcinogenesis and aging. Different systems exist to protect aerobic organisms from deleterious effects arising from oxygen activation. They include the enzymes, superoxide dismutase, catalase and peroxidases. Moreover, most living organisms on this planet possess genetic networks to repair DNA damage by reactive oxygen species. In this light, the short-term symposium on "Role of Oxygen in Biological Actions of Radiation" was held at our institute on January 23 to 24, 1987 to review and discuss the current state and the future direction of research on this field. This proceedings is the compilation of the papers presented at the symposium, covering aspects of radiation chemistry, biochemistry and molecular biology of oxygen activation and oxygen toxicity. The mechanism of production of active oxygen by radiolysis of aqueous solution is discussed with respect to the involvement in biological systems. A paper is included on physiology of thylakoid Q/sub B/ protein as an example of the protection mechanism against oxidative damage. The active oxygen-induced DNA damage and its repair are described, and the cloning and nucleotide sequence of the gene which governs oxygen sensitivity is presented. The involvement of active oxygen in carcinogenesis and aging is also in the volume.

19575 **(LA-UR—88-267) Restoration of Chinese hamster cell radiation resistance by the human repair gene ERCC-5 and progress in molecular cloning of this gene.** Strniste, G.F.; Chen, D.J.; deBruin, D.; McCoy, L.S.; Luke, J.A.; Mudgett, J.S.; Nickols, J.W.; Okinaka, R.T.; Tesmer, J.G.; MacInnes, M.A. (Los Alamos National Lab., NM (USA)). 1988. Contract W-7405-ENG-36. 7p. (CONF-880157—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005396/JAW.

From Symposium on molecular and cellular biology; Taos, NM, USA (24 Jan 1988).

The uv-sensitive Chinese hamster cell uv-135 is being used to identify and isolate the human gene, ERCC-5, which corrects nucleotide excision repair in this incision-defective mutant. A cosmid library, constructed from a 3° transformant of uv-135, has been screened for transfected gpt and human Alu family sequences. An ordered physical map of overlapping positives cosmids has been determined. Molecular evidence suggests a region of this map of <40 Kbp contains the ERCC-5 gene. 10 refs., 2 figs.

19576 **(PNL-SA—13956) Degradation or consumption of exogenous thymidine in absence or presence of exogenous deoxycytidine: Effect on DNA chain elongation and [^{3}H]thymidine incorporation in control and uv-irradiated CHO-K1 cells.** Newman, C.N.; Hagler, M. (Pacific Northwest Lab., Richland, WA (USA); Northwest Coll. and Univ. Association for Science, Richland, WA (USA)). Apr 1986. Contract AC06-76RL01830;FG06-86ER75235. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005628/JAW.

When CHO-K1 cells monolayers are grown in Ham's F-12 culture medium containing 10% fetal calf serum (medium A) exogenous thymidine (dThd) is degraded to thymine by a putative dThd phosphorylase. Thymine is then poorly incorporated into cellular DNA. When 2 mM deoxycytidine (dCyd) is added to medium A (medium B) no degradation of exogenous dThd occurs; rather dThd is consumed in the synthesis of DNA, presumably via a dThd kinase or other nucleoside salvage pathway. Differences in the kinetics of DNA synthesis, measured by [^{3}H]dThd pulse-incorporation or by alkaline sucrose velocity sedimentation, are observed in the two media. In comparison to cells in medium A, DNA chain elongation rates of cells in medium B are faster but total DNA synthesis in these cells, measured by incorporation of [^{3}H]dThd, appears to be 2- to 3-fold more sensitive to the inhibitory effects of 10 Jm^{-2} uv-radiation. 23 refs., 3 figs.

19577 **(PNL-SA—15055) Modeling the biological effectiveness of high-LET [linear-energy-transfer] radiation.** Miller, J.H.; Wilson, W.E. (Pacific Northwest Lab., Richland, WA (USA)). Dec 1987. Contract AC06-76RL01830. 17p. (CONF-871066—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005152/JAW.

From Modelling for scaling to man: biology, dosimetry and response; Richland, WA, USA (20 Oct 1987).

Reevaluation of neutron exposures to A-bomb survivors has greatly reduced the significance of that data base for estimating the relative biological effectiveness of radiations with high linear-energy-transfer (LET). Consequently, greater emphasis is being given to animal data and mechanistic studies at the cellular and molecular level in accessing the role of radiation quality in the health effects of low-level radiation exposure. We are investigating the spatial patterns of energy deposited in DNA by ionizing radiation and their influence on cell killing and mutation induction. Our basic hypothesis is that high ionization density increases the probability that radiation-induced DNA damage will be unrepairable or misrepaired. To develop this hypothesis further, we need a better understanding of the relationships among energy absorbed in DNA, conformational change, and reactivity of repair enzymes. We expect the Molecular Sciences Research Center at PNL to be a valuable resource for obtaining this information. 9 refs., 5 figs.

19578 Thermal response of biological tissues. Gow, K.K.; Liburdy, J.A.; Liburdy, R.P. (Lawrence Berkeley Lab., Berkeley, CA 94720). pp 41 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

A model of the thermal response of various biological tissues is required to predict how these tissues will respond to localized heating, cooling, and radiation deposition. For accurate modelling of the heat transfer processes of the tissues, two properties, thermal conductivity and heat capacity, are required. These properties and their variations with temperature have been determined for human erythrocytes, normal lung cells, lung squamous cells, normal and transformed mammary epithelial cells. Similarly, properties have been obtained for normal WAG/R/sub ij/ rat and rat Rhabdomyosarcoma cells. The heat capacity is obtained by placing the sample in a small, thin-walled sphere and subjecting it to a heated, constant temperature, constant velocity flow field. The time rate change of tissue temperature is analyzed to determine the heat capacity. Thermal conductivity measurements are made with a heat flux gage which establishes a steady heat flux through a standard and the tissue sample. The heat flux is determined by means of a differential temperature measurement across the standard. The specimen thermal conductivity is found by measuring the temperature differential across the sample. Detailed thermal conductivity and heat capacity data are presented over the temperature range of approximately 30-45°C. Normal versus abnormal cells are compared and results related to modelling considerations.

19579 Joint oxygen-glucose deprivation model for necrosis. Hlatky, L.; Alpen, E.L.; Sachs, R.K. (Univ. of California at Berkeley, Lawrence Berkeley Lab., Biology and Medicine Div., Berkeley, CA 94720). pp 57 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

The authors propose a model for necrosis in solid tumors and in tumor analogues. The model asserts that necrosis is caused by a joint shortage of both oxygen and glucose; the specific trigger for necrosis is assumed to be a drop in the per cell ATP production rate to a given fraction of the production rate under normal conditions. Supporting data is shown. The model is compared to observations of sandwiches and spheroids of various cell lines. Numerical integration of coupled non-linear integral equations for glucose and oxygen concentration profiles as determined by semi-empirical per-cell consumption functions is used to theoretically compute the width of the viable cell borders. The calculated profiles and calculated viable cell border widths are compared to some experimental ones found in the authors laboratory and others reported in the literature.

19580 Modeling radical yields in oriented DNA exposed to high LET radiation. Miller, J.H.; Wilson, W.E.; Swenberg, C.E.; Charlton, D.E. (Pacific Northwest Lab., Richland, WA). pp 34 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—). Contract AC06-76RL01830.

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

The authors are developing a model for the orientation dependence of radical yields that is observed when DNA fibers, prepared by the wet spinning technique, are exposed to neutrons. When the neutron flux is incident approximately parallel to the DNA fibers, the yield of the 5-6 dihydrothyml (TH) radical is enhanced relative to its yield when the neutron flux is perpendicular to the DNA. They attribute this orientation dependence of the TH yield to asymmetry in the thermal conductivity of the fibers that allows rapid migration of energy along a DNA molecule but not between molecules. Hence, multiple interactions between a recoil proton and a DNA molecule, which occur with significant probability only in the parallel irradiation geometry, can activate the proton-transfer reaction that produces TH from the thymione radical anion. Preliminary results, that are based on computer simulation of 1 MeV proton tracks in water, show more than an order of magnitude enhancement of TH yields by this mechanism with physically reasonable model parameters.

19581 The radiation response of murine erythroid progenitors (CFU/sub E/). Berger, S.E.; Alpen, E.L. (Biology and Medicine Div., Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 75 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—). Contract AC03-76SF00098.

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

The radiation response of murine erythroid progenitors (CFU/sub E/) to irradiation followed by in situ holding and to split dose irradiations was investigated. LAF/sub 1//JAX female mice were whole body irradiated with 150 kVp X rays. The femoral bone marrow was extracted to assay for CFU survival by the plasma clot culture method. In situ holding experiments were performed in which 2.0 Gy was delivered, and the CFU/sub E/ were allowed to remain in situ for various time intervals between irradiation and culturing. The surviving fraction sharply declined from 0.21 for CFU/sub E/ cultured immediately after irradiation to a minimum value of 0.04 for irradiated CFU/sub E/ held in situ for 1.5 hours prior to culturing. Subsequently, the surviving fraction increased rapidly approaching immediate plating values within 6 hours of in situ holding. In split dose experiments a conditioning dose of 0.8 Gy was administered at "time zero," and at various time intervals after the first dose, a second dose of 0.8 Gy was delivered. The CFU/sub E/ were cultured immediately after the delivery of the second dose. A pattern similar to that for in situ holding experiments was observed. The surviving fraction decreased from 0.24 for 1.6 Gy delivered in one dose to 0.06 for split doses separated by 45 minutes. The surviving fraction then rose to 0.2 for split doses separated by 6 hours. The possible roles of repair, division and intercompartmental transitions in the above phenomena are discussed.

19582 Halogenated pyrimidines as radiosensitizers for high LET radiation. Archer, R.W.; De Graff, W.; Moore, M.; Mitchell, J.B. (Chemistry Div., Argonne National Lab., Argonne, IL). pp 111 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

Incorporation of halogenated pyrimidines into cellular DNA sensitizes cells to x-rays. Recent clinical interest in these sensitizers has prompted the authors to question whether halogenated pyrmidine incorporation affords cellular radiosensitization for high LET radiation such as neutrons. Chinese hamster V79 cells were grown in medium containing 10 μM iododeoxyuridine (IdUrd) for approximately 2 cell doublings (17 hours). This exposure resulted in approximately 16% replacement of thymidine with IdUrd. Cells were exposed to graded doses of 15 MeV photons or fission spectrum neutrons (10 keV - 3MeV) at a dose rate of 1 Gy/min. Neutron irradiations were performed using the AFRRI Triga reactor (gamma component = 3%). Dose response survival curves revealed that incorporation of IdUrd sensitized cells to both x-rays and neutrons. The enhancement ratio's (ratio of dose for control versus IdUrd pretreated cells at 1% survival) for x-rays was 1.8 while that for neutrons was 1.5. These data suggest a role for halogenated pyrimidine radiosensitizers in neutron radiation therapy for carefully selected tumor sites where incorporation of the radiosensitizer will be greater in the tumor as opposed to the surrounding normal tissues.

19583 Future directions for radiological physics: An interface with molecular biology. Braby, L.A. (Pacific Northwest Lab., Richland, WA). pp 115 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—). Contract AC06-76RL01830.

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

Recent experiments with low energy x-rays and fast molecular ions have shown that the products of the interaction of several ionizations within a few nanometers dominate radiation effects. However, the authors still can only make assumptions about the physical and chemical nature of this initial damage. Enzymatic repair of DNA damage is another key factor, but they have little idea of what governs the success or failure (misrepair) of these processes. Unresolved problems like these dictate the future direction of radiological physics. Molecular biology techniques are being applied to determine molecular alterations which result in observed damage. Interpretation of these experiments will require new data on the physics of energy transfer to macromolecules and the stochastics of energy deposition in time. Future studies will attempt to identify the initial damage, before biological processes have amplified it. This will require a detailed understanding of the role of chromatin structure in governing gene expression, the transport of energy within macromolecules, the transport of ions and radicals in the semiordered environment near DNA strands, and many other physical characteristics within the living cell.

19584 **Modification of radiation response in V79 cells with solcoseryl.** Sigdestad, C.P.; Nagy, B.; Grdina, D.J. (Argonne National Lab., Argonne, IL 60439). pp 121 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—). Contract W-31-109-ENG-38.

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

Solcoseryl is a deproteinized extract of calf serum which has been used for various purposes. It has been shown to simulate wound healing, to protect against carbon monoxide poisoning and to prevent teratogenic effects of cyclosphosphamide in mice. In addition, it has been reported to be a radiation protector and to modify radiation response in patients undergoing radiation treatment. The present study attempted to assess the effect of Solcoseryl on V79 cell survival and DNA damage after gamma irradiation. WR-1065 (4mM) was tested for comparative purpose. DNA damage was assayed using the alkaline elution technique while cell survival was determined in vitro using a standard clongenic assay. The results indicate that Solcoseryl doses protect against single-strand DNA breaks (SSB) but has little if any protective effect on cell survival. WR-1065- however, protects against both SSB and survival after gamma irradiation.

19585 **Direct measurements of intramolecular electron transfer rates between cytochrome c and cytochrome c peroxidase: effects of exothermicity and primary sequence on rate.** Cheung, E.; Taylor, K.; Kornblatt, J.A.; English, A.M.; McLendon, G.; Miller, J.R. (Concordia Univ., Montreal, Quebec). *Proceedings of the National Academy of Sciences of the United States of America;* **83**: No. 5, 1330-1333(Mar 1986). Contract W-31-109-ENG-38.

Rapid mixing of ferrocytochrome c peroxidase [cyt c peroxidase(II)] and ferricytochrome c [cyt c(III)] results in the reduction of cyt c(III) by cyt c peroxidase(II). In 10 mM phosphate, pH 7.0, the rate of decay of cyt c peroxidase(II) and the rate of accumulation of cyt c(II) give equal first-order rate constants. Equivalent results are obtained by pulse radiolysis using isopropanol radical as the reducing agent. This rate is independent of the initial cyt c(III):cyt c peroxidase(II) ratios. These results are consistent with unimolecular electron transfer occurring within a cyt c(III)-cyt c peroxidase(II) complex. When cyt c is replaced by porphyrin cyt c (iron-free cyt c), a complex still forms with cyt c peroxidase. On radiolysis intracomplex electron transfer occurs from the porphyrin cyt c anion radical to cyt c peroxidase(III). This large rate increase suggest that the barrier for intracomplex electron transfer is large. Finally, the authors have briefly investigated how the cyt c peroxidase(II) → cyt c(III) rate depends on the primary structure of cyt c(III). They find the reactivity order to be as follows: yeast > horse > tuna.

19586 **Recombinational DNA double-strand break repair is a quantitatively consistent explanation of T4 multiplicity reactivation.** Lange, C.S.; Perlmutter, E.; De Leon, J.; Knee, R. (SUNY Downstate Med. Center, Brooklyn, NY). pp 91 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

One DSB/genome has been shown to explain ca. 76% of T4 loss of plaque-forming ability. Infectious center assays were performed, at various multiplicities of infection, and their results compared with predictions based on the proportion of cells expected to be infected by: a) undamaged T4; b) ≧2 T4 containing a non-DSB potentially lethal lesion (PLL, lethal in singlet infection); c) ≧2 T4 both containing ≧1 DSB; or d) 1 T4 containing ≧ 1 DSB or a non-DSB PLL. The number of infectious centers were found to be consistent with a+b+c, at low dose (ca. 1 DSB/genome), but decreased, consistent with a lower DSB repair efficiency (ca.1 DSB repaired/genome) at higher dose (ca. 2, 3.5, 5.5 DSB/genome). Therefore, DSB repair takes place during multiplicity reactivation (MR) and is quantitatively consistent with being the only significant cause of MR. Experiments with genetically identical recA hosts showed that the MR observed is independent of the host recA system and may depend only on phage-coded enzymes.

19587 **Measurement of DNA repair in Chinese hamster fibroblasts employing flow cytometry and monoclonal antibodies to DNA adducts.** Hoy, C.A.; Rice, G.C.; Strickland, P.; Gray, J.W.; Dolbeare, F.; Hahn, G.M. (Lawrence Livermore Lab., Livermore, CA). pp 91 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

The authors examined the utility of measuring DNA repair in single cells employing flow cytometric quantitation of fluorescent monoclonal antibodies directed against specific DNA adducts. Two antibodies were employed; the first directed against single strand (ss) bromodeoxyuridine (anti-BrdUrd) and the second against UV light induced ss-thymine dimers (anti-TT). Sensitivity with both monoclonals was highly dependent on DNA denaturation, with the most effective shown to be a 0.5N HCl histone extraction followed by 50% formamide for 30 min at 80°C. Unscheduled synthesis following 30 J/m/sup 2/ UV irradiation in Gl/GO plateau phase CHO cells was demonstrated employing the anti-BrdUrd AB method combined with DNA counter-staining with propidium iodide. Data suggest that anti-BrdUrd Ab recognition of newly replicated sequences following UV irradiation may be strongly dependent on chromatin conformation. A linear correlation was observed for mean anti-TT AB fluorescence and UV dose up to a total of 3000 J/m/sup 2/. Also, a rapid reduction in cellular fluorescence, presumably reflecting dimer excision was observed when the cells were returned to 37°C before fixation. Finally, data from various repair deficient CHO cells will be compared employing these methods.

19588 **Viral probe studies of intracellular repair and secondary induction of DNA strand breaks.** Krisch, R.E.; Flick, M.B. (Univ. of Pennsylvania, Philadelphia, PA). pp 89 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

The authors developed an alternative experimental approach to the study of intracellular repair of DNA strand breaks by higher cells, based on the use of SV40 virus, which lacks intrinsic DNA repair capacity and possesses a minirichromosome structure as an intracellular test molecule or probe. This approach involves a combination of gel electrophoresis for separation of several classes of damaged viral DNA molecules and DNA hybridization for detection and quantitation of these molecules. The authors show rapid and efficient cellular uptake of SV40, independent of prior radiation dose to the virus, and excellent recovery and quantitation of the

three DNA forms, using their multistep procedure. Radiation dose-response experiments with purified extracellular SV40 virus give results closely comparable to those obtained with techniques in current use. Time-course incubation experiments with SV40 infected CV-1 monkey kidney cells demonstrate slow but extensive intracellular repair of SSB and very limited repair of DSB. More recently, the authors observed the self-induction of significant numbers of DSB following prolonged intracellular incubation of irradiated virus.

19589 **Chromatin condensation and decondensation are determinant processes in the fixation of radiation-induced cytogenetic damage.** Pantelias, G.E.; Wolff, S. (Univ. of California, San Francisco, CA). pp 91 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

When cells are irradiated, the number of chromosome aberrations found at metaphase are related to the stage of the cell cycle at which the irradiation took place. Thus, cells in G/sub 2/ are more sensitive than G/sub 1/ or S cells. Furthermore, when mitotic cells with completely condensed chromosomes are irradiated, no aberrations are found until the cells divide and chromosomes decondense and subsequently recondense to form the next metaphase. To test the effect of chromosome decondensation on the yield of aberrations, the authors irradiated condensed CHO chromosomes in metaphase, allowed the cells to divide and then looked at the interphase prematurely condensed chromosomes (PCCs) in the daughter cells by fusing them with miotic cells. To test the effect of chromosome condensation, the authors irradiated G/sub 0/ human lymphocytes and examined them at different times after fusion with mitotic cells, i.e., as condensation proceeded. The results show that after lesions are produced, the yield of aberrations found in PCCs is related to the amount of chromosome movement manifested as either chromatin condensation or decondensation.

19590 **Effects of X-rays on DNA synthesis in a temperature sensitive mammalian cell.** Yezzi, M.J.; Blakely, E.A.; Tobias, C.A. (Lawrence Berkeley Lab., Berkeley, CA). pp 92 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—). Contract AC03-76SF00098.

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

Using /sup 3/H-TdR pulse labelling, the authors autoradiographically demonstrated a delay in the progression of synchronized G1-phase and S-phase cells after inhibition of protein synthesis. When G1-phase CHO-TSH1 cells are treated for 2 hrs or 4 hrs at 40°C (each of these treatments inhibits protein synthesis), the populations are delayed in their entry into S phase by approximately 5.5 hrs or 10 hrs, respectively, and then they proceed through a normal DNA synthetic phase. When S-phase cells are treated for 2 hrs or 4 hrs at 40°C, a transient increase in the % labelled cells is observed after the cells are returned to their normal growth temperature of 35°C. If the cells were exposed to 5.5 Gy of X-rays after a 2-hr, or during a 4-hr excursion at 40°C, the transient increase in the % labelled cells was observed to be reduced in magnitude by a factor of 1.7, and prolonged in duration by about 5 hrs. This observation is suggestive of extra DNA being synthesized during the recovery period. A discussion of the possible nature of the extra synthetic activity is presented.

19591 **X-ray studies on a two-dimensional diffusion limited system for cell growth.** Hlatky, L.R.; Alpen, E.L. (Lawrence Berkeley Lab., Berkeley, CA). pp 78 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

X-ray studies were performed on cells grown in a new type of in vitro multicellular system, the "sandwich" system. This system is a two-dimensional array of cells, sandwiched between transparent slides which are impermeable to oxygen. The cell system is subject to self-created diffusion gradients of nutrients, metabolic products and, most importantly, oxygen. Sandwiches are analogous to living cross sections of multicellular spheroids or of poorly vascularized tumors. They contain a necrotic center, which the authors show to be due to diffusion limitations, an intermediate region which has a large fraction of quiescent cells and a cycling outer rim. One advantage sandwiches have over three-dimensional tumor models (sheproids) is that can control the amount of cell to cell contact and thereby separate effects due to oxygen or other gradients from effects due to contact. The authors present x-ray survival curves for sandwiches of various cell densities and compare them to x-ray survival curves done for spheroids and monolayers of the same cell line.

19592 **Radiation survival of quiescent cells from tumor spheroids.** Freyer, J.P.; Schor, P.L. (Los Alamos National Lab., Los Alamos, NM). pp 78 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

The authors have been studying the radiation survival of non-proliferating (quiescent) cells which develop in multicellular tumor spheroids (MTS) as a model of similar cell subpopulations in tumors. The use of selective dissociation enabled us to isolate very pure populations of quiescent cells from spheroids. These cells were characterized using bromodeoxyuridine (BrdU) incorporation with fluorescein-labelled monoclonal anti-BrdU antibody analysis on a flow cytometry system or on histological slides of intact spheroids, by standard DNA content analysis, and by cellular regrowth outside the MTS. Quiescent cells were irradiated either in situ under normal culture conditions, in situ under conditions of uniform nutrient (oxygen and glucose) supply, or after isolation from the MTS. The results from EMT6/Ro mouse mammary and HT1080 human colon spheroids indicate that quiescent cells exposed to radiation under identical nutrient conditions are slightly more sensitive to radiation than their exponentially-growing counterparts. For in situ exposures under normal conditions, the presence of hypoxia was a more important determinant of radiation survival than the presence of a quiescent cell compartment.

19593 **(INIS-BR—935) Physiological alterations in UV-irradiated cells: liquid holding recovery.** Aragao, B.R. (Rio de Janeiro Univ. (Brazil). Inst. de Biofisica). 1980. 137p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number TI88701472/JAW.

The biochemical and physiological alterations that occur in ultraviolet irradiated cells, during liquid holding have been studied. Incubation in buffer acts not to interfer directly with the mechanic repairs but by promoting metabolic alterations that would block some irreversible and lethal physiological responses. (L.M.J.).

19594 **(JINR-R—19-87-469) Radiosensitivity-LET dependence in yeasts. Theoretical analysis.** Lobachevskij, P.N.; Krasavin, E.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 10p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701512/JAW.

Submitted to the journal Radiobiology.

A mathematical model to explain the dependence of radiosensitivity on linear energy transfer (LET) in yeast is proposed. The model takes into account the role of radiation damage repair processes in yeast cell sensitivity to ionizing radiations of different LET. Two types of repair are considered: non-specific repair (common for haploid and diploid cells) and diploid-specific one (characteristic of diploid cells only). 25 refs.

19595 **(JINR-R—19-87-470) Radiosensitivity-LET dependence in yeasts. Experiments on haploid cells.** Lobachevskij, P.N.; Krasavin, E.A.; Cherevatenko, A.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701513/JAW.

Submitted to the journal Radiobiology.

On the basis of the model reported earlier an analysis was made of the experimental dependence of radiosensitivity (D/sub 0//sup -1/) of haploid yeast Saccharomyces cerevisiae (wild type and radiosensitivity mutant) upon linear energy transfer (LET, L). The dependence D/sub 0//sup -1/(L) of haploid yeast was shown to be determined, to a certain extent, by ability of cells to repair radiation-induced damages. Whereas the radiosensitivity-LET dependence of wild type cells has a maximum, in the case of radiosensitive mutant defective in repair of radiation-induced damafes, this dependence is described by a falling-down curve. 9 refs.; 3 figs.; 2 tabs.

19596 **Accessibility of gamma-irradiated SV40 viral DNA to host cell degradation and repair.** Krisch, R.E.; Flick, M.B. (Dept. of Radiation Therapy, Univ. of Pennsylvania School of Medicine, Philadelphia, PA 19104). pp 53 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

The authors used extracellularly gamma-irradiated simian virus 40 (SV40) as a probe for the study of intracellular repair of DNA strand breaks by mammalian cells. They now find, after analysis of many repeated experiments, that single and double strand DNA breaks (SSB and DSB) are not measurably repaired in host cell nuclei. In contrast to the preliminary results reported earlier, time course experiments involving up to 6 hours post-infection intranuclear incubation show the same distribution of strand break damage as do unincubated samples. This indicates that there is neither intracellular degradation nor repair of radiation-damaged viral DNA. The reasons for this unexpected finding are unknown at present, but they suspect that accessibility of viral DNA to host cell enzymes is important. Pure SV40 DNA, irradiated or unirradiated, lacking the mini-chromosome structure present in the intact virus, sustains additional strand breaks during intracellular incubation when transfected into host cells and later recovered from nuclei. Experiments in progress are investigating the accessibility of other types of DNA damage to host enzymes, specifically by pre-infection treatment of SV40 with H/sub 2/O/sub 2/ or UV irradiation.

19597 **Cellular repair of unique DNA base damages produced by ionizing radiation.** Laspia, M.F.; Wallace, S.S. (Dept. of Microbiology and Immunology, New York Medical College, Valhalla, NY 10595). pp 106 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

Escherichia coli endonuclease III and exonuclease III are postulated to repair X-ray-induced DNA damages. Endo III nicks X-irradiated DNA and DNA containing pyrmidine radiolysis products. Exo III is the major AP activity in E. coli and recognizes alkali-stable urea residues. The authors found that phiX-174 transfecting DNA containing thymine glycols or urea residues is inactivated at a greater rate in hosts deficient in endo III (nth) or exo III (xth), respectively than in wild type hosts. Thymine glycols are unique in the fact that they undergo SOS reactivation without concomitant mutagenesis. They found that thymine glycol-containing DNA is inactivated at the same rate in lex(Def) mutants as in wild type, in spite of the fact that SOS genes are fully derepressed in this strain. However, reactivation of thymine glycol-containing DNA does occur when lex(Def) mutants are UV-irradiated prior to transfection or when mutants with a constitutive RecA protease are used as hosts. In addition, no reactivation occurs when SOS-induced umuC mutants are used as hosts. These results suggest a requirement for RecA protease in the reactivation of thymine glycols in addition to its role in derepressing the SOS response and that the reactivation of thymine glycols is dependent on the combined action of RecA protease and UmuD,C gene products.

19598 (N—88-12251, pp vp) **Effect of radiation on the long term productivity of a plant based CELSS.** Thompson, B.G.; Lake, B.H. (New York Univ., NY). Sep 1987. NTIS, PC A08/MF A01. (NASA-CP—2480; A—87256; NAS—1.55:2480; CONF-8607360—).

From Controlled ecological life support system conference: regenerative life support systems in space; Toulouse, France (1 Jul 1986).

Mutations occur at a higher rate in space than under terrestrial conditions, primarily due to an increase in radiation levels. These mutations may effect the productivity of plants found in a controlled ecological life support system (CELSS). Computer simulations of plants with different ploidies, modes of reproduction, lethality thresholds, viability thresholds and susceptibilities to radiation induced mutations were performed under space normal and solar flare conditions. These simulations identified plant characteristics that would enable plants to retain high productivities over time in a CELSS.

19599 **(AD-A—186072/5/XAB) AFRRI (Armed Forces Radiobiology Research Institute) reports, April, May, June 1987. Technical report.** (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). Jul 1987. 136p. NTIS, PC A07/MF A01.

Includes rept. nos. AFRRI-SR87-10 through AFRRI-SR87-22, AFRRI-TR86-5 and AFRRI-TR86-6.

This document is a collection of reprinted technical reports. Partial contents include: Effect of ionizing radiation on prostaglandins and gastric secretion in rhesus monkeys; Characterization of rat prothymocyte with monoclonal antibodies recognizing rat lymphocyte membrane antigenic determinants; Effects of subdiaphragmatic vagotomy on the acquisition of a radiation-induced condition taste aversion; Ethanol-induced taste aversions; Lack of involvement of acetaldehyde and the area postrema; Dose and time relationships of the radioprotector WR-2721 on locomotor activity in mice; Purification and analysis of rat hematopoietic stem cells by flow cytometry, Plasma histamine and catecholamine levels during hypotension induced by morphine and compound 48/80; Effects of ionizing radiation on hippocampal excitability, Tumor necrosis factor/cachectin is a less-potent inducer of serum amyloid A synthesis than interleukin 1, Protection of mice against fission-neutron irradiation by WR-2721 or WR-151327, Induction of colony-stimulating factor in vivo by recombinant interleukin 1 a and recombinant tumor necrosis factor alpha; 16,16-Dimethyl prostaglandin E2 increases survival in mice following irradiation, Selenium pretreatment enhances the radioprotective effect and reduces the lethal toxicity of WR-2721; Rat phantom depth dose studies in electron, x-ray, gamma-ray, and reactor-radiation fields; Wall attenuation and scatter characteristics of ionization chambers at Armed Forces Radiobiology Research Institute.

19600 **(CONF-871188—2) Environmental radiation standards and risk limitation.** Kocher, D.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003291/JAW.

From Annual meeting of the Society for Risk Analysis; Houston, TX, USA (1 Nov 1987).

The Environmental Protection Agency and Nuclear Regulatory Commission have established environmental radiation standards for specific practices which correspond to limits on risk to the public that vary by several orders of magnitude and often are much less than radiation risks that are essentially unregulated, e.g., risks from radon in homes. This paper discusses a proposed framework for environmental radiation standards that would improve the correspondence with limitation of risk. This framework includes the use of limits on annual effective dose equivalent averaged over a lifetime, rather than limits on dose equivalent to whole body or any organ for each year of exposure, and consideration of exposures of younger age groups as well as adults; limits on annual effective dose equivalent averaged over a lifetime no lower than 0.25 mSv (25 mrem) per practice; maintenance of all exposures as low as reasonably achievable (ALARA); and establishment of a generally applicable de minimis dose for public exposures. Implications of the proposed regulatory framework for the current system of standards for limiting public exposures are discussed. 20 refs.

19601 (CONF-8709104—12) **Population exposure from the fuel cycle: Review and future direction.** Richmond, C.R. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003639/JAW.

From ANS topical conference on population exposure from nuclear fuel cycle; Oak Ridge, TN, USA (15 Sep 1987).

The legacy of radiation exposures confronting man arises from two historical sources of energy, the sun and radioactive decay. Contemporary man continues to be dependent on these two energy sources, which include the nuclear fuel cycle. Radiation exposures from all energy sources should be examined, with particular emphasis on the nuclear fuel cycle, incidents such as Chernobyl and Three Mile Island. In addition to risk estimation, concepts such as de minimis, life shortening as a measure of risk, and competing risks as projected into the future must be considered in placing radiation exposures in perspective. The utility of these concepts is in characterizing population exposures for decision makers in a manner that the public may judge acceptable. All these viewpoints are essential in the evaluation of population exposure from the nuclear fuel cycle.

19602 (CONF-8710260—1) **Saturation in dual radiation action.** Rossi, H.H.; Zaider, M. (Columbia Univ., Irvington-on-Hudson, NY (USA). Nevis Labs.). 1987. Contract FG02-86ER60402;FG02-86ER60449. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004998/JAW.

From Symposium on quantitative mathematical models in radiation biology; Giessen, F.R. Germany (1 Oct 1987).

The development of the principles of the theory of dual radiation action is reviewed and a treatment of saturation is given. Although the relationship derived cannot be evaluated in general in closed form, approximations may be obtained that apply to a range of conditions. 20 refs.

19603 (DOE/ER/60282—3, pp 2, Paper 1) **Mechanisms of permanent and delayed radiation pathology.** Casarett, G.W. [1987]. NTIS, PC A02/MF A01. Order Number DE88005907/JAW. Contract FG02-85ER60281.

In [Studies of radiation and chemical toxicity: Final report].

In the studies of radiation induction of tumors, considerable progress was made in preliminary analyses of dose-time-incidence relationships and absolute induction vs. temporal advancement, for overall site-specific tumors, with respect to variables such as dose range and dose rate, whole-body vs. localized x-irradiation, rat strain, treatment or not with tumor promoters, and period of ascertainment. Similar analyses will be applied to specific tumor types according to cells of origin, malignancy and other characteristics. Considerable progress was made in histopathologic studies for these purposes and for investigation of pathogenic mechanisms. 10 refs., 6 figs.

19604 (DOE/ER/60539—3) **The oncogenic action of ionizing radiation on rat skin: Progress report, February 1, 1987-January 31, 1988.** Burns, F.J. (New York Univ., NY (USA). Dept. of Environmental Medicine). 1987. Contract FG02-87ER60539. 38p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002637/JAW.

The work outlined in this report includes: epidermal DNA strand breaks and radiation penetration; activation of oncogenes in radiation induced rat skin tumors; and rat skin carcinogenesis by neon ions. The effect of radiation penetration on DNA single strand breaks has been studied extensively in rat and mouse epidermis. The results show clearly that the number of strand breaks per unit dose in the epidermal DNA is reduced by 50% to 65% when the radiation penetration is reduced from 1.0 mm to 0.2 mm. This penetration effect on DNA strand breaks was not seen in mouse epidermal cell lines growing in plastic dishes. The results imply that DNA strand breakage in superficial cells is partially dependent on the radiation dose to underlying tissue. The phenomenon is not mediated by systemic interactions as it was observed in irradiated explanted skin. The oncogene activation pattern in the radiation-induced skin tumors was found to be tumor dependent. Either K-ras activation or c-myc amplification or both was observed in each tumor analyzed so far. Even benign fibromas exhibited c-myc amplification. The carcinogenicity of high penetration electrons (2.0 MeV) was determined in preparation for similar studies with a neon ion beam at the Berkeley Bevelac. The principal finding so far is a large excess of connective tissue tumors, fibromas (benign) and sarcomas (malignant). 59 refs., 1 tab.

19605 (INIS-SU—432, pp 215) **Radiomodifying agents of tinidazole and short time induced hyperglycemia in combined treatment of patients with cervix uterine carcinoma.** Baran, L.A.; Vinnitskaya, V.K.; Nonko, V.D.; Dovbishchenko, V.A.; Gol'dshmid, B.Ya.; Fokin, A.V.; Lisetskij, V.A. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19606 (INIS-SU—432, pp 582-583) **T-lymphocytes and their functional activity following complex treatment of patients with mammary gland cancer.** Yarygin, L.M.; Malyshev, V.S. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19607 (PNL-SA—15141) **Population and worker exposure from high-level waste production and management.** Faust, L.G.; Stephan, J.G.; Selby, J.M. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 12p. (CONF-8709104—11). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003947/JAW.

From ANS topical conference on population exposure from nuclear fuel cycle; Oak Ridge, TN, USA (15 Sep 1987).

This paper compares the estimates of radiological exposure for nuclear industry workers with those for offsite populations. Occupational exposures, which are routine and chronic, are always measurable because of the control conditions and available of proper equipment. By comparison, doses to the offsite public results from very diluted concentrations of radionuclides in the environment, resulting from restricted releases of radioactive materials or (under unusual circumstances) the transportation of wastes. Thus, estimates of doses to the offsite public must take into account the release and transport of radiation through the environment, and therefore must be calculated rather than measured. Data are provided showing that production and waste-management activities at those Department of Energy (DOE) sites have resulted in reported occupational doses of up to 500 mrem/man-year while offsite, population doses have averaged up to 0.05 mrem/person, with a maximum individual annual dose of up to 0.7 mrem. By comparison, a commercial jet flight of five hours may result in a dose of 2.5 mrem, depending on altitude and geographic latitude. 11 refs., 2 tabs.

19608 **Leukocyte subset analysis on blood from workers exposed to plutonium in 1944-45.** Stevenson, A.P.; Habbersett, R.C.; Stewart, C.C. (Los Alamos National Lab., Los Alamos, NM 87545). pp 77 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

Monoclonal antibodies (MAbs) directed against cell surface markers were used to identify specific subpopulations of lymphocytes and monocytes obtained from 22 male subjects who had /sup 239/Pu exposures in 1944-45. Separated mononuclear cells were labelled simultaneously with fluoresceinated B1 (B cells), phycoerythrin Leu2a (T/sub S/ cells), Leμ M3 with Texas-red goat-anti-mouse Ig and biotinylated Leμ3 with allophycocyanin avidin (T/sub H/ cells). In addition, the DNA-specific stain Hoechst 33342 was used to identify nucleated cells and to provide information on cell cycle status. Flow cytometric analysis using 3-color excitation (UV, 488 nm and 605 nm) was used, and 5 colors of emission were detected, corresponding to the four MAbs and Hoechst. The mononuclear cells were analyzed on the day of collection or after irradiation with 0, 50 or 200 rads followed by 6 days in culture with or without PHA stimulation. Marked differences in all measured param-

eters were found among the workers. The most striking response was a dose-related increase in the T/sub H//T/sub S/ ratio.

19609 **(CONF-830462—Vol.2) The transfer of radioactive materials in the terrestrial environment subsequent to an accidental release to atmosphere, Volume 2: Proceedings.** (Commission of the European Communities, Luxembourg. Directorate for Health and Safety; Commission of the European Communities, Brussels (Belgium)). Jul 1983. 292p. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88900335/JAW.

From Seminar on the dynamics of the transfer to man of radioactive materials deposited subsequent to an accidental release to atmosphere; Dublin, Ireland (11 Apr 1983).

The fact that tritium can be incorporated into organic molecules renders the description and modelization of tritium transfer more complex than that of other radionuclides such as Sr and Cs. Tritium taken up in organic form is a more efficient precursor of organically bound tritium (OBT) in the body of animals than is tritium water. Moreover, compartments of OBT have widely differing turnover characteristics, some of them with very long half-lifes. Whereas continuous release will eventually result in the same specific activity for organic and inorganic tritium, organic tritium may play a greater role following an accidental release. The amount of tritium transferred in inorganic and organic form to animals and man will depend on the growth prevailing during the release and the form (dried or fresh) under which the plants are consumed. Such differences are less marked for other radionuclides such as cesium and strontium. The parameters and their uncertainties for uptake and metabolism of tritium in plants are reviewed and the possibilities for modelisation are discussed and compared with the situation for caesium and strontium. Individual papers are processed separately.

19610 (IA—1427, pp 161-162) **Lymphocyte transformation as a measure of protection by MPG.** Oren, A.; Kol, R.; Marko, R.; Riklis, E. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19611 (IA—1427, pp 170-171) **Hypophyseal response to GnRH neonatally irradiated mature female rats.** Freud, A.; Sod-Moriah, A. (Israel Atomic Energy Commission, Tel Aviv; Ben-Gurion Univ. of the Negev, Beersheba, Israel). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19612 (IA—1427, pp 172-173) **Leydig cell populations of the adult rat affected by neonatal exposure to a low dose of gamma radiation.** Canfi, A.; Bedrak, E.; Chayoth, R. (Israel Atomic Energy Commission, Tel Aviv; Ben-Gurion Univ. of the Negev, Beersheba, Israel). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19613 **(INCT—2003/4/B/B) Changes in plasma membrane state of thymocytes during spontaneous and radiation-induced leukemogenesis.** Gonta-Grabiec, K. (Institute of Nuclear Chemistry and Technology, Warsaw (Poland)). 1984. 119p. (In Polish). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88701310/JAW.

Published in 1985. Received in Dec 1987.

Changes in plasma membrane properties characteristic for malignant cells were reviewed. Investigations of spontaneous (in AKR mice) and radiation-induced (in C57Bl) leukemogenesis were carried out; changes in properties of Na/sup +/, K/sup +/ ATPase and alkaline phosphatase were characterized. On the basis of the results reported a pre-leukemic stage was distinguished, corresponding to the following features at the cellular level: increase in activity of alkaline phosphatase; decrease in relative activity of Na/sup +/, K/sup +/ ATPase; decrease in efficiency of the Na/sup +/ K/sup +/ pump; decrease in cAMP content. 473 refs.

19614 (INIS-SU—432, pp 235) **Increase in antitumoral radiation effect with metronidazole and short-time hyperglycemia in relation to schedules of fractionation and single dose.** Vepkhvadze, N.R. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19615 (INIS-SU—432, pp 490) **Functional state symphathoadrenal system in case of nonoperable lung cancer in chemoradiation treatment.** Balitskaya, E.K.; Kas'yanenko, I.V.; Shmal'ko, Yu.P. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19616 **(INIS-SU—432) 4. All-union conference of oncologists. Summaries of reports.** (Ministerstvo Zdravookhraneniya SSSR, Moscow; Ministerstvo Zdravookhraneniya SSSR, Moscow. Vsesoyuznoe Nauchnoe Obshchestvo Onkologov). 1986. 204p. (In Russian). (CONF-8612118—). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW.

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

The proceedings of the Fourth All-Union Conference of Oncologists are contained in this document. Individual reports contained within are also indexed for the data base.

19617 **(UCRL—15989) Chromosomal aberrations, reproductive success, life span, and mortality in irradiated Neanthes arenaceodentata (polychaeta).** Anderson, S.L.; Harrison, F.L.; Chan, G.; Moore, D.H. II. (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005415/JAW.

The polychaete worm Neanthes arenaceodentata ws used in experiments to determine possible relationships between short-term genotoxicity tests and reproductive and lethal consequences of exposure to ionizing radiation. Groups of juvenile N. arenaceodentata received one of four different radiation doses (2, 4, 8, and 16 Gy) to determine dose-effect estimates for chromosomal aberration induction, and groups of both adult and juveniles received one of seven different radiation doses (1, 4, 8.4, 46, 102, 500, and 1000 Gy) to determine dose-effect estimates for reproduction, mortality, and life span. Effects on reproduction and genetic material were observed at the lowest doses and in the same range; detrimental reproductive effects were observed at 1 to 4 Gy, and the frequency of chromosomal aberrations were significantly increased at 2 Gy. Only high doses resulted in acute mortality (>500 Gy) and decreased life span (>100 Gy). Dose-effect estimates for chromosomal aberration induction were dependant on radiation dose and on the stage of the cell cycle at the time of irradiation. Dose-effect estimates for reproduction were dependant on dose and the potential for repopulation of gonadal tissue. Such knowledge is required because factors, such as cell-cycle effects, may modify dose-effect estimates. It is concluded that short-term genotoxicity tests can be predictive of detrimental reproductive effects in those model systems for which basic cell kinetics and reproductive parameters are well known. 4 refs., 11 figs., 13 tabs.

19618 **Lung cancer in rats exposed by inhalation to mixed plutonium and uranium oxide nuclear fuels.** Hahn, F.F.; Mewhinney, J.A.; Scott, B.R.; Seiler, F.A. (Lovelace Inhalation Toxicology Research Institute, Albuquerque, NM 87185). pp 73 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—). Contract AC04-76EV01013.

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

The relationship of radiation dose and resulting biological effects in lung was investigated after inhalation by rats of two types

of plutonium-containing particulate materials. The materials were a PuO/sub 2/ feedstock treated at 850°C and a solid solution of uranium and plutonium ((U, Pu)O/sub 2/) treated at 1750°C collected from gloveboxes at a mixed oxide fuel fabrication facility. Groups of rats received a single inhalation exposure to achieve graded levels of initial pulmonary burden and were maintained for lifespan observation. Cancers of the lung, both carcinomas and sarcomas, were the major effects seen. Incidences of these cancers were similar at comparable levels of initial pulmonary burden for the two materials. Crude incidence of lung cancers for rats exposed to either of these materials was not different than that reported for similar studies using laboratory produced PuO/sub 2/. The doubling dose for lung cancers after exposure to PuO/sub 2/ or (U, Pu)O/sub 2/ was 0.78 +- 0.63 Gy to lung to median lifespan. These studies indicate that the risks of lung cancer from inhaled mixed oxide fuels and PuO/sub 2/ are the same.

19619 **Phase-specific cell survival and evidence for host cell toxicity following x-irradiation of rat rhabdomyosarcoma tumors.** Tenforde, T.S.; Kavanau, K.; Afzal, S.M.J.; Curtis, S.B. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA 94720). pp 82 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—). Contract AC03-76SF00098.

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

Rat rhabdomyosarcoma R-1 tumors (the R2C5 subline) were irradiated in situ with 10 Gy of 225-kVp X rays, excised from the host and dissociated with dispase at times ranging from 0 to 16 days post-irradiation, stained with 5 μM Hoechst 33342 (2 hr., 37°C, analyzed for cellular DNA content by flow cytometry and sorted into G-1, S and (G-2 + M) populations, and assayed in vitro for colony-forming ability. The following observations were made: (1) the tetraploid tumor cells exhibit a pronounced G-2 block at 1 day following in situ irradiation; (2) a 20% increase in the fraction of diploit host cells occurs in tumors at 2-3 days postirradiation; (3) tumor cell survival drops by a factor of 20 at 2.5 days postirradiation; (4) relative to the unsorted cell population (tumor + host cells), the dip in cell survival at 2.5 days postirradiation is substantially less in the G-1, S and (G-2 + M) sorted tumor cell populations; (5) the survival of sorted tumor cell populations can be reduced significantly by the radiation of host diploid cells obtained from irradiated tumors; (6) the cytotoxicity of host diploid cells is observed only at 2.5 days or later following tumor irradiation. These results indicate that delayed host immune reactivity to X-irradiated R2C5 cells is responsible for a significant decrease in the surviving fraction of tumor cells beginning at 2-3 days postirradiation.

19620 **Low LET radiation dose rate effect and free radical production and survival.** Bateman, J.L.; Bond, V.P. (Brookhaven National Lab., Upton, NY 11973). pp 51 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

The authors previously published the finding that LD-50/30 varied with the reciprocal cube root of x- or gamma-radiation dose rate in a number of studies by others in mice and rats. Human skin erythema also appeared to fit the relationship. Broyles subsequently employed a modification of the relationship with particular interest in dose rates of less than 6 rad per day. Having noted a deflection of actual data from reciprocal cube root- predicted values at higher dose rates in the earlier utilized studies, they modified the original relationship with the finding of a better fit of data from a broad variety of endpoints to predicted values. These end-points include E. Coli survival, murine lens opacification, spermatogonia depletion, and abnormal liver anaphases, skin erythema in man and swine, LD 50/4 in mice and rats, LD-50/30 in mice, rats, and swine, and LD-50/60 in sheep. ED-50 specific loss of dose-rate effect appears to occur with several of the quoted parameters at very high dose rates (greater than 1000 rad per minute). The possible role of oxygen depletion and free radical production and survival.

19621 **An integrated analysis of the life-shortening effects in mice of fission neutrons and /sup 60/Co γ rays.** Grahn, D.; Carnes, B.; Thomson, J.F. (Argonne National Lab., Argonne, IL 60439). pp 81 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—). Contract W-31-109-ENG-38.

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

Ten studies on the life-shortening and tumorigenic effects of /sup 60/Co γ rays and fission neutrons from the JANUS reactor have been completed. Young adult B6CF/sub 1/ males and females were exposed to brief single, 24 once-weekly, or 60 once-weekly doses of either radiation and followed for their lifetimes. Two studies involved γ rays delivered in five 22-h days per week for either 23 or 59 elapsed weeks. The mean aftersurvival (MAS) data were analyzed to determine the influence of total dose, sex, exposure pattern, radiation quality, and nonadditive interactions among these factors on dose-response relations between MAS and total dose. Each γ-ray-exposure pattern produces a unique, linear, dose-rate-dependent life-shortening coefficient, which ranges from 0.43 days lost/cGy for single doses to 0.08 days lost/cGy for single doses to 0.08 days lost/cGy for the continuous (59 five-day week) exposures. For total neutron doses below 15 cGy, there is no significant nonlinear (D/sup 2/) term and no apparent dose-rate effect. A significant negative D/sup 2/ term emerges at doses ≧ 20 cGy. Linear coefficients from progressive analyses of data between 1 and 40 cGy are between five and seven days lost/cGy for females and three and four days lost for males. Data between doses of 1 and ≧ 60 cGy are not depicted by a simple dose-response model. RBE/sub m/ lies between 40 and 60 for each sex and could reach 90, if sex differences are ignored.

19622 **Changes in the mouse lens caused by 600 MeV/amu accelerated iron ions.** Worgul, B.V.; Medvedovsky, C.; Powers-Risius, P.; Alpen, E.L. (Eye Radiation Research Lab., Columbia Univ.). pp 109 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

The lenses of mice were evaluated by slit-lamp biomicroscopy and cytopathological analysis following doses of 600 MeV/amμ iron ions ranging from 0.05 to 1.6 Gy. The examinations were conducted at 5, 10 and 16 months post-irrdiation. Cataracts were present in all irradiated animals although the severities were dose- and time-dependent. The degree of opacification observed in the .05 Gy dose group indicated that the threshold dose for cataractogenesis must be significantly lower. Furthermore, when compared to results from previous low-LET radiation studies in the mouse lens a relatively high RBE is suggested for iron ions. In addition to the overt loss of transparency, histopathological analyses revealed a strong dose dependence for a number of endpoints. These included micronucleation, interphase death, and meridional row disorganization. Previous studies have shown that X-ray cataracts and meridional row disorganization correlate quantitatively. Taken together, the microscopic changes support the view that the mechanism of heavy ion induced cataractogenesis is the same as that for cataracts caused by low-LET radiation. The damage incurred in the lens by heavy particles while quantitatively dissimilar is qualitatively indistinguishable from that caused by X-rays.

19623 **Lethality from radiation pneumonitis and pulmonary fibrosis after combined alpha and beta irradiation of the lung.** Scott, B.R.; Hahn, F.F.; Snipes, M.B.; Newton, G.J.; Eidson, A.F.; Mauderly, J.L.; Boecker, B.B. (Lovelace Inhalation Toxicology Research Institute, Albuquerque, NM 87185). pp 108 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

Equal numbers of male and female F344/CRLLOV rats (total number = 288) 15 weeks of age were exposed by inhalation to the alpha emitter /sup 238/Pu, the beta emitter /sup 147/Pm, or

to mixtures of both (in the same particle), inhaled in a matrix of fused aluminosilicate particles (FAP). Thirty-six control rats inhaled nonradioactive FAP. The experiment was conducted to validate the hazard function (HF) model for acute lethality after exposure to both high- and low-LET radiation. Pulmonary function measurements were carried out on surviving rats at 1.5 years after inhalation exposure. The HF model allows one to predict when a sublethal high-LET dose and a sublethal low-LET dose in combination should be lethal. Observed and predicted acute lethality dose-effect surfaces are compared and dose-effect surfaces for impaired pulmonary function are presented.

19624 **Effects of X-rays on immune response in skin.** Triplett, L.L.; Fry, R.J.M. (Biology Div., Oak Ridge National Lab., Oak Ridge, TN 37831). pp 110 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—).

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

It has been shown that ionizing radiation reduces the Langerhans cell population in the skin. Less is known about the effect of irradiation on the immune responses in the skin. The authors experiments were designed to determine the effect of soft x rays on delayed type (DTH) and contact hypersensitivity (CHS) in SKH-hr-1 female mice. DTH was measured as the increase in footpad thickness 24 hrs after injection of an illiciting dose of sheep RBC. The sensitizing injection of sheep RBC had been given in the opposite footpad 4 days earlier. CHS was determined using 2, 4, 6,-trinitro-chlorobenzene (TNCB). The mouse was sensitized by applying the agent to the abdomen and challenged 6 days later on the ear. Footpad and ear measurements were made with a Microstat digital electronic micrometer. Mice were exposed to single and multiple doses of 25 Kv x rays (HVL of 0.085 mm Al) and assessed at 7 and 21 days. The SKH-hr-1 female mouse shows a decrease in sensitivity after the x ray treatment and remains depressed for 21 days.

19625 **(LBL—24173) BEIR-IV: The effects on populations of exposure to internally deposited alpha-emitting radionuclides, 1987: Health risks of radon and other internally deposited alpha-emitters.** Fabrikant, J.I. (Lawrence Berkeley Lab., CA (USA)). Sep 1987. Contract AC03-76SF00098. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004897/JAW.

This report attempts to respond to a broad range of scientific questions that impact current public health issues; not all of these questions can be addressed adequately with currently available information. There is considerable variation in the amount of data from epidemiologic studies of human populations and from experimental animal investigations that are available for each radionuclide. For certain of the alpha-emitting radionuclides, such as radon and its daughters, radium and thorium, human epidemiological data are available. For others, however, such as the transuranic elements, some useful information is available on humans; accordingly, dependence must be placed on extensive experiments with animals. As in all experimental studies with animals, the extent to which the information and conclusions can be extrapolated to humans and the confidence that can be placed on such an extrapolation remain uncertain. Where human data are available, wherever possible the Committee has relied on its own analyses using current epidemiological methods to address these problems rather than relying solely on published information. The Committee has also explored statistical methods for analysis of interspecies comparisons of the risks from different radionuclides where useful animal data are available and the human data are limited.

19626 **(DOE/ER/60449—T1) Research in theoretical radiobiology and radiological physics: Final technical report, May 1, 1986-December 31, 1987.** Rossi, H.H. (Columbia Univ., New York (USA). Dept. of Radiation Oncology). Dec 1987. Contract FG02-86ER60449. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004524/JAW.

The work carried out under this Grant included continuation of experimental research in radiation biophysics that was previously initiated, as well as extensive theoretical efforts primarily devoted to the further development of the Theory of Dual Radiation Action. Documents for international and national organizations were prepared or evaluated. Attendance at a number of international and national meetings and scientific correspondence were also in part supported by this grant. 14 refs.

19627 **(DOE/EV/03382—T1) Radioactivity studies: Final report, June 1985-August 1986.** Ralston, L.; Cohen, N. (ed.). (New York Univ., NY (USA). Medical Center). Nov 1987. Contract AC02-76EV03382. 124p. (COO—3382-23). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88003253/JAW.

We instigated studies of neptunium metabolism in two nonhuman primate species to derive dosimetric parameters necessary for accurate human radiation risk assessments. The metabolism of neptunium was studied in adult female baboons and tamarins following intravenous injection and intragastric intubation. Neptunium-237 and ^{239}Np isotopes were prepared as citrate, nitrate, and bicarbonate complexs with valence states of +4, +5 and +6. Samples of blood, urine, feces and autopsy tissues were measured by both gamma-ray and alpha spectrometry techniques. Retention of injected neptunium was determined in vivo using whole and partial body gamma-scintillation spectroscopy. Immediately following intravenous injection, neptunium (+5 and +6) cleared rapidly from blood, deposited primarily in the skeleton (54 +- 5%) and liver (3 +- 1%), and was excreted predominately via urine (40 +- 3%). For the first year post injection, neptunium was retained with a composite biological half-time of 100 yrs in liver and 1.5 yrs in bone. In comparison, injected Np(+4) was retained in blood in higher concentrations and was eliminated initially via urine to a lesser extent (12%). Np(+4) was deposited primarily in the carcass (38 +- 4%) and liver (43 +- 4%). Differences in the chemical forms and radionuclide concentrations injected did not alter neptunium metabolic patterns. 78 refs., 20 figs., 30 tabs.

19628 (INIS-SU—432, pp 545-546) **Chromosomal aberrations and oncogenic effect in rats after administration of /sup 35/S in their organism.** Monakhov, A.S. 1986. (In Russian). NTIS (US Sales Only), PC A10/MF A01. Order Number DE88780049/JAW. (CONF-8612118—).

From 4. All-Union conference of oncologists; Leningrad, USSR (1 Dec 1986).

19629 **(PNL-SA—15202) Time-related factors in the study of risks in animals and man.** Gilbert, E.S.; Park, J.F.; Buschbom, R.L. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1988. Contract AC06-76RL01830. 21p. (CONF-871066—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005685/JAW.

From Modelling for scaling to man: biology, dosimetry and response; Richland, WA, USA (20 Oct 1987).

Data from epidemiological studies of humans exposed to potentially harmful substances are usually analyzed using methods that account for the dependence of risks on time-related factors such as age and follow-up period. Recently developed statistical procedures allow modeling of the age-specific risks as a function of dose as well as factors such as age at exposure, time from exposure, exposure duration, and dose rate. These procedures potentially allow more rigorous inferences and clearer understanding of the patterns of risks observed in epidemiological studies than has been available in the past. Statistical procedures that consider time-related factors can also be applied to laboratory animal data, and provide information that is useful for the problem of extrapolating from animal studies to humans. By applying such procedures to data on exposure to the same substance in different species (including humans) or to different substances in the same species, a better understanding of the relationship of risks across species and across substances can be achieved. In addition, such statistical procedures allow appropriate treatment of exposure that is accumulated over time and lead to improved understanding of patterns of risk over time. The approach is illustrated using data from a lifespan study of beagle dogs exposed to inhaled plutonium. 12 refs., 1 fig., 3 tabs.

19630 **Plant root absorption and metabolic fate of technetium in plants.** Cataldo, D.A.; Garland, T.R.; Wildung, R.E. (Pacific Northwest Lab., Richland, WA, USA). pp 265-280 of Technetium in the environment. Seminar on the behaviour of technetium in the environment held in Cadarache (FR) on 23-26 October 1984. Desmet, G.; Myttenaere, C. (eds.). Barking, England; Elsevier Applied Science Publishers Ltd. (1986). (CONF-8410157—).

From Scientific seminar on the behavior of technetium in the environment; Cadarache, France (23 Oct 1984).

In this series of studies with TcO/sub 4//sup -/, root absorption characteristics and tissue distributions are discussed and the chemical fate of Tc in plants is described and compared with that of Selenium and Sulphur. Vegetable and agricultural species used included the carrot, cabbage, lettuce, pea, mustard, radish, leek, bunch and bulb onion, soybean, alfalfa and garlic.

19631 **Chemical form of technetium in corn (Zea mays) and the gastrointestinal absorption of plant-incorporated Tc by laboratory rats.** Garten, C.T.; Myttenaere, C.; Vandecasteele, C.M.; Kirchmann, R.; Van Bruwaene, R. (Oak Ridge National Lab., TN, USA; Louvain Univ., Belgium. Lab. de Physiologie Vegetale; Centre d'Etude de l'Energie Nucleaire, Mol, Belgium). pp 319-332 of Technetium in the environment. Seminar on the behaviour of technetium in the environment held in Cadarache (FR) on 23-26 October 1984. Desmet, G.; Myttenaere, C. (eds.). Barking, England; Elsevier Applied Science Publishers Ltd. (1986). (CONF-8410157—).

From Scientific seminar on the behavior of technetium in the environment; Cadarache, France (23 Oct 1984).

Based on the results of the chemical extractions, almost 40% of the sup(95m)Tc biologically incorporated into corn leaves via root uptake is present in the plant tissue in forms that are not readily extractable, except by boiling 2 M NaOH. The 'bound' forms of sup(95m)Tc in the leaves appear to be mostly Tc complexes with proteins and polysaccharides of the plant cell walls. Once assimilated, technetium was rapidly excreted from most tissues except thyroid and hair. The study confirms the result of Sullivan et al., which showed that incorporation of sup(95m)Tc into plant tissues (soybeans) resulted in decreased gastrointestinal absorption by rats and guinea pigs relative to the absorption of inorganic sup(95m)Tc. Associations with organic molecules in plants are perhaps partly responsible for the lowered availability of technetium from the GI tract when it is incorporated into vegetation. The diminished availability of sup(95m)Tc incorporated into corn leaves may also be due to the poor digestibility of this particular diet in the rat intestine.

19632 **Distribution of orally administered and chronically fed sup(95m)Tc in Japanese quail tissues and eggs.** Thomas, J.M.; Cadwell, L.L.; Cataldo, D.A.; Garland, T.R. (Pacific Northwest Lab., Richland, WA, USA). pp 349-357 of Technetium in the environment. Seminar on the behaviour of technetium in the environment held in Cadarache (FR) on 23-26 October 1984. Desmet, G.; Myttenaere, C. (eds.). Barking, England; Elsevier Applied Science Publishers Ltd. (1986). (CONF-8410157—).

From Scientific seminar on the behavior of technetium in the environment; Cadarache, France (23 Oct 1984).

In the present study, male and female Japanese quail were chronically fed alfalfa grown on solutions containing TcO/sub 4/ which was mixed into a commercial turkey starter. The objective was to estimate concentration ratios and transfer coefficients from Tc incorporated into alfalfa tissue to quail eggs, edible tissues and other organs.

19633 **Computer programs for the analysis of cell survival data.** Albright, N.W. (Lawrence Berkeley Lab., Berkeley, CA). pp 79 of Thirty-third annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1985). (CONF-8505113—).

From 33. annual scientific meeting of the Radiation Research Society; Los Angeles, CA, USA (5 May 1985).

These computer programs enable the user to enter cell survival data, fit various survival curves, plot a fitted survival curve together with the data points, calculate doses that produce specified survival levels, calculate OER and RBE or other dose ratios of two fitted curves, and plot this pair of survival curves together with the data points. The programs calculate standard deviations or confidence intervals of fitted survival calculate parameters, OER, and RBE. The programs calculate survival curves for linear quadratic, repair saturation, single-hit multitarget, linear multitarget, and repair-misrepair models. Multiple plating efficiencies are calculated as least squares fitting parameters for data that is a combination of multiple datasets. The programs perform either non-robust least squares fitting or robust fitting with Tukey's bisquare weight. A priori weights can be included, and the programs have been used to study new approaches to weighting data points. Several examples of in vitro cell survival data illustrate the use of the programs. The programs run on a VAX computer and can be used with a variety of graphics terminals.

5602 Thermal Effects

REFER ALSO TO CITATION(S) 18196

5603 Chemicals Metabolism And Toxicology

REFER ALSO TO CITATION(S) 17618, 17636, 17889, 18136, 19112, 19115, 19116, 19117, 19118, 19119, 19120, 19123, 19134, 19176, 19181, 19185, 19190, 19192, 19197, 19201, 19206, 19208, 19209, 19239, 19327, 19329, 19330, 19555, 19566, 19580, 19584, 19589, 19592, 19596, 19597, 19620, 19621, 19622, 19623

19634 **(BNL—40648) Effects of 2-aminoanthracene and benzo(α)pyrene on interferon production in human foreskin fibroblasts.** Chen, Yu-Shiaw; Vaughn, J.M.; Morales, D. (Brookhaven National Lab., Upton, NY (USA)). Nov 1987. Contract AC02-76CH00016. 18p. (CONF-8711150—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005602/JAW.

From ISIR meeting on the interferon system; Washington, DC, USA (2 Nov 1987).

Human foreskin fibroblast cell cultures (Flow 7000, FS-35) were treated with varying concentrations of 2-aminoanthracene or benzo(α)pyrene for a two-day period prior to interferon (IFN) induction by either poly I . poly C, or 'Vesicular' Stomatitis virus (VSV). IFN in test cell fluids was then assayed and compared to production in untreated cultures. Both cell lines produced similar amounts of beta-interferon in response to poly I . poly C simulus. However, Flow 7000 fibroblasts were extremely sensitive to benzo(α)pyrene, with concentrations as low as 1 μM treatment inhibiting 93% of IFN-β productivity. Treatment of FS-35 cells with ten times this concentration was required to inhibit 85% of IFN-β productivity. Both test chemicals inhibited IFN-β productivity in FS-35 fibroblasts to the same extent. It was also noted that FS-35 produced alpha-interferon in response to VSV challenge, but this production was vulnerable to treatment with both test chemicals. In all cases, observed levels of IFN inhibition were directly proportional to the concentration of the applied chemical. 1 fig., 4 tabs.

19635 **(CONF-870524—2) Chlorine sensitivity of early life stages of freshwater fish.** Tsai, Shan-Ching, Mattice, J.S.; Trabalka, J.R.; Burch, M.B.; Packard, K.B. (Oak Ridge National Lab., TN (USA); Science Applications International Corp., Oak Ridge, TN (USA); Electric Power Research Inst., Palo Alto, CA (USA); Varton Heights Veterinary Hospital, Stroudsburg, PA (USA); Centenary Coll., Shreveport, LA (USA)). 1985. Contract AC05-84OR21400. 18p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003776/JAW.

From 6. conference on water chlorination: environmental impact and health effects; Oak Ridge, TN, USA (3 May 1987).

To determine the toxicity of chlorine to the most sensitive life stages of fish, we developed a flow-through system suitable for measuring the acute toxicity to all life stages of fish, from 1-h old embryos to 256-d old fingerlings, and then measured LC50 values for free residual chlorine to three species of fish at various life stages. 14 refs., 5 figs., 2 tabs.

19636 (CONF-870940—1) Ranking of PAH [polynuclear aromatic hydrocarbons] carcinogenic potencies. Glass, L.R.; Easterly, C.E. (Texas Univ., Houston (USA). Health Science Center; Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 21p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004735/JAW.

From 11. international symposium on polynuclear aromatic hydrocarbons; Gaithersburg, MD, USA (23 Sep 1987).

The proposed framework for the analysis of tumorigenicity data permits an independence from statistical models and simultaneously allows for a hierarchal approach to estimates of carcinogenic potency. The proposed framework makes no assumptions inferring that certain bioassays are more appropriate than others. It attempts to use all available data, and thereby provides a balance in the overall analysis by standardizing data for a test compound to the data for a reference compound and utilizing data of the central region of the resulting distribution as the summary statistic. This type of framework may be of value in guiding the development and interpretation of analytic measures. The results demonstrate a consistency in the ranking of the carcinogenic potencies of representative PAHs using information from the largest single source of toxicologic data in the public domain. Admittedly, these correlations will remain empirical relationships until the biological mechanisms are elucidated. 22 refs., 5 tabs.

19637 (CONF-870940—2) DNA damage as a biological marker in aquatic organisms exposed to benzo[a]pyrene. Shugart, L.R.; Jimenez, B.D.; McCarthy, J.F. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005436/JAW.

From 11. international symposium on polynuclear aromatic hydrocarbons; Gaithersburg, MD, USA (23 Sep 1987).

We show that minute quantities of BaPDE-DNA adducts in the liver of bluegill sunfish can be detected and quantitated using a simple analytical technique whose sensitivity depends upon the intrinsic fluorescence of the specific adduct being analyzed. These adducts represent damage to DNA of the organism, which, if left uncorrected, could trigger a sequence of events that culminate in the appearance of an overt malignancy. We believe that the data reported here demonstrate that the covalent interaction of genotoxic chemicals with cellular macromolecules such as DNA is, potentially, a sensitive biological marker which could be of early predictive value in assessing exposure and its significance. 13 refs., 1 fig., 1 tab.

19638 (CONF-8706206—3) Comparative developmental and phenotypic properties of altered hepatocyte foci and hepatic tumors in rats initiated neonatally with different doses of diethylnitrosamine and promoted with dietary phenobarbital. Peraino, C.; Carnes, B.A.; Stevens, F.J. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003896/JAW.

From Department of Energy contractor's meeting on chemical toxicity; Monterey, CA, USA (23 Jun 1987).

Studies in this laboratory indicate that members of the diverse spectrum of hepatic lesions appearing in rats given a single neonatal treatment with carcinogen followed by promotion with dietary phenobarbital are developmentally independent. Our more recent experiments provide a more definitive evaluation of the developmental relationships among these lesions by subdividing the altered hepatocyte focus population into foci that were detectable solely by histochemical means and those that also showed morphological aberrations and comparing the developmental and phenotypic properties of the hist(+), morph-) foci, hist(+), morph(+) foci, and hepatic tumors in rats initiated once neonatally with different doses of diethylnitrosamine and promoted with dietary phenobarbital from weaning. Rats were killed at intervals, and their livers were examined for tumors and for the two classes of altered hepatocyte foci. Through application of serial frozen-sectioning techniques (2) and computer-assisted image analysis (3), foci containing between one and seven histochemical markers and/or exhibiting morphologic changes were identified and sized. The same complement of histochemical tests was applied to the hepatic tumors observed in this investigation. 3 refs.

19639 (CONF-8710221—1) Production of PCDFs and related products from PCBs: An overview. Erickson, M.D. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002865/JAW.

From Electric Power Research Institute PCB seminar; Kansas City, MO, USA (6 Oct 1987).

Several workers have demonstrated that in the laboratory the formation of PCDFs from PCBs at elevated temperatures is feasible. This work went largely unnoticed by those concerned with the scientific, toxicity, regulatory, and product liability issues surrounding PCBs until February 1981 when a fire in a PCB-containing transformer in the Binghamton, New York State Office Building brought PCB fires to international attention. Since that event, numerous other PCB fires and related events have underscored the need to draft new regulations from the US EPA and to place other legal restrictions in various countries, increased removal of PCB-containing electrical equipment from service, financial pressure from insurance companies, much better and faster cleanup and verification of the cleanup, and more research. 17 refs., 1 tab.

19640 (CONF-8710247—1) Interactive effects of natural and anthropogenic factors on growth and physiology of southern red spruce. McLaughlin, S.B.; Andersen, C.P.; Hanson, P.J.; Norby, R.J.; Edwards, N.T.; Tardiff, R.R. (Oak Ridge National Lab., TN (USA); Phyton Technologies, Oak Ridge, TN (USA)). 1987. Contract AC05-84OR21400. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003766/JAW.

From Research symposium on the effects of atmospheric pollution in spruce and fir forests in the Eastern United States and the Federal Republic of Germany; Burlington, VT, USA (19 Oct 1987).

Field and laboratory studies are underway to characterize physiologial changes associated with the decline of red spruce (Picea rubens Sarg.) at high elevations in the Great Smocky Mountains National Park. Two research plots have been established on Clingman's Dome at 1720 m and 1935 m elevations to document the magnitude of growth changes at sites experiencing varying degrees of growth decline and to explore the physiological basis of observed differences. The objective is to evaluate likely mechanisms of action and identify natural and anthropogenic factors influencing the observed growth patterns. Field measurements include historical and current radial growth of mature trees and saplings, and seasonal patterns of carbon assimilation, carbon allocation, and water relations of saplings. Laboratory experiments include dose response exposures with H_2O_2, toxicity screening studies with Al, Mn, and Ca, and characterization of the foliar uptake and metabolism of nitrogen oxides. 9 refs., 2 figs., 6 tabs.

19641 (DOE/EP/31111—1-Vol.1, pp 2G.1-2G.25) Heavy metals in selected fish, shrimp, and dissected tissue of Atlantic croaker in the Calcasieu River/Lake Complex. Carmouche, E.F.; Webre, C.L.; Ramelow, G.J.; Beck, J.N. 26 Jun 1987. NTIS, PC A18/MF A01. Order Number DE88002683/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 1, Introduction, executive summary, physicochemical parameters: Final report, Sampling dates: October 1983-August 1986.

Concentrations of the heavy metals Ba, Co, Fe, Hg, Sc, Se, and Zn were measured in selected dissected tissue of Atlantic croaker (Micropogonias undulatus). Whole body, flesh, kidneys, gastrointestinal tract, and gill tissues were examined. Samples were collected throughout Calcasieu Lake and also in the Calcasieu River just above and below the lake. Large enrichments of heavy metals in the GI tract and kidneys of Atlantic croaker were found. The heavy metals were also measured in other organisms including white shrimp (Peanaeus setiferus) and brown shrimp (Penaeus aztecus), as well as the following fishes: gulf menhaden (Brevoortia patronus), silver sea trout (Cynoscion nothus) and spot (Leiostomus xanthurus). No variations with sampling locations were found for metal concentrations for all species. However, variation in concentrations were found in the uptake rates of certain metals; for example, mercury was significantly enriched in shrimp relative to fish species studied.

19642 (DOE/EP/31111—1-Vol.1, pp 2H.1-2H.34) **Variations of heavy metals in fish and other organisms from the Calcasieu River/Lake Complex.** Ramelow, G.J.; Webre, C.; Mueller, C.S.; Beck, J.N.; Young, J.; Langley, M.P. 26 Jun 1987. NTIS, PC A18/MF A01. Order Number DE88002683/JAW.

In Ecosystem analysis of the Calcasieu River/Lake Complex (CALECO): Volume 1, Introduction, executive summary, physicochemical parameters: Final report, Sampling dates: October 1983-August 1986.

Several species of fish and other marine organisms inhabiting the Calcasieu River/Lake Complex were analyzed for As, Cd, Cr, Cu, Pb, Hg, Ag, and Zn. Concentrations for all metals measured within species and among species were found to show no significant variation with sampling location. Differences in elemental concentrations appear to be related to organism mobility and not to site-specific variations in metal loadings. Different species of finfish contained only trace amounts of As (< 0.1 - 0.3 mg kg^{-1}), Cd (0.02 - 0.08 mg kg^{-1}), Ag (< 0.01 - 0.08 mg kg^{-1}), and Pb (< 0.2 - 0.5 mg kg^{-1}). Concentrations of Cu and Cr were found to be highly variable, in contrast to Zn, which was present in relatively constant concentrations across all species (28 +/- 7 mg kg^{-1}). Sessile organisms such as oysters were found to have the highest concentrations of heavy metals including Cd.

19643 (DOE/ER/60282—3) **[Studies of radiation and chemical toxicity: Final report].** (Rochester Univ., NY (USA). Medical Center). [1987]. Contract FG02-85ER60282. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005907/JAW.

Four related studies assessing the potential of Vitamin E to affect biological damage by radiation. Each study has been separately abstracted and indexed for the Energy Data Base.

19644 (DOE/ER/60282—3, pp 2, Paper 2) **[Neurobehavioral toxicity of organometallic fuel additives].** Weiss, B. [1987]. NTIS, PC A02/MF A01. Order Number DE88005907/JAW. Contract FG02-85ER60282.

In [Studies of radiation and chemical toxicity: Final report].

All fuels contain non-fuel additives. Manganese tricarbonyl has been proposed as a substitute for lead, but far less is known about its toxicity. The research conducted under this grant was designed to extend current knowledge of manganese neurotoxicity.

19645 (DOE/ER/60282—3, pp 4, Paper 4) **[Uptake, metabolism, location, and protective antioxidant functioning of vitamin E in lung].** Mavis, R.; Finkelstein, J. [1987]. NTIS, PC A02/MF A01. Order Number DE88005907/JAW. Contract FG02-85ER60281.

In [Studies of radiation and chemical toxicity: Final report].

Studies describing experiments designed to assess to the antioxidant effects of vitamin E, the distribution of vitamin E after its intravenous injection, the transport of tocopherol across cellular membranes, and the ability of vitamin E to modulate lung damage by NO_2. 10 refs.

19646 (DOE/ER/60367—T2) **Effects of SO_2 and sulfite on stromal metabolism.** Anderson, L.E.; Muschinek, G.; Marques, I. (Illinois Univ., Chicago (USA). Dept. of Biological Sciences). 1986. Contract FG02-85ER60367. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004258/JAW.

SO_2 appears to have multiple effects on chloroplast stromal metabolism. What is unique about metabolism in the chloroplast is reductive modulation of enzyme activity. The evidence summarized here implicates both the components of the modulation process and the light modulated enzymes and ribulosebisphosphate carboxylase in SO_2-sensitivity. Interference with electron transport, acidification of the stroma, and depletion of phosphates will further complicate metabolism in the photosynthesizing chloroplast when sensitive plants are exposed to SO_2. 35 refs., 6 figs.

19647 (DOE/ER/60493—1-Vol.1, pp 524-528) **Genotoxic contribution of woodsmoke to indoor respirable suspended particles.** Boone, P.M.; Rossman, T.G.; Daisey, J.M. (New York Univ. Medical Center, NY). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The genotoxicity of dichloromethane extracts of indoor respirable particulate matter, with and without woodsmoke, were measured with the Microscreen bioassay. Non-systematic changes in background dose-response curves upon metabolic activation and the addition of woodsmoke suggest numerous non-combustion sources of toxic, mutagenic, and metabolically active compounds exist in homes.

19648 (DOE/ER/60493—1-Vol.1, pp 97-101) **Human reactions to indoor air pollution: N-decane.** Kjaergaard, S.; Moelhave, L.; Pedersen, O.F. (Univ. of Aarhus, Denmark). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A dose-response study of human reactions to n-decane was performed in a climate chamber. Sixty-three healthy subjects, randomly selected from the normal population were exposed to n-decane concentrations of either 0, 10, 35 or 100 ppm in a controlled double blind study using a latin square exposure design. The most significant findings related to indoor air quality were dose-dependent changes in irritation of mucous membranes, sensation of increased odor intensity and reduced air quality. Adaptative changes were seen at the highest exposure levels, but not at the levels relevant for non-industrial environment. among the physiological measurements the tear film stability decreased in all exposed groups. In conclusion, even small concentrations of the relatively inert n-decane gave symptoms similar to those in the WHO definition of the sick building syndrome.

19649 (DOE/ER/60493—1-Vol.1, pp 117-121) **Influence of personal activities on exposure to volatile organic compounds.** Wallace, L.A.; Hartwell, T.D.; Perritt, K.; Sheldon, L.S.; Michael, L.; Pellizzari, E.D. (Environmental Protection Agency, Washington, DC). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Personal exposures of seven subjects to organic compounds were measured while they engaged in selected common activities. Exposures to 11 chemicals were often increased by factors of 10 or 100.

19650 (DOE/ER/60493—1-Vol.1, pp 133-138) **Benzene in the breath and blood of general public.** Brugnone, F.; Perbellini, L.; Faccini, G.B.; Pasini, F. (Universita di Verona, Italy). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

In individuals belonging to a hospital staff, a benzene level of 14 ng/l in the alveolar air and 269 ng/l in the blood was measured. Environmental benzene level in the hospital was 5 ng/l. In a first group of workers occupationally exposed to benzene, 16 hours after the end of the workshift, benzene level was 70 ng/l in the alveolar air and 597 ng/l in the blood. In a second group of workers non occupationally exposed to benzene, the level of benzene was 28 ng/l in the aveolar air, and 256 ng/l in the blood. In the air of plant infirmary, 58 and 36 ng/l of benzene were found for the first and second group, respectively, of the workers. Biological benzene levels were significantly higher in smokers than in non-smokers among the hospital staff and the second group workers, but not in smokers of the first group workers.

19651 (DOE/ER/60493—1-Vol.1, pp 239-242) **Avoidable and unavoidable exposition of indoor-chemicals.** Korte, F.; Gebefuegi, I. (Institut fuer Okologische Chemie, Neuherberg, Germany, F.R.). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The presence of chemicals in indoor air can lead to whole body contamination. Exposure can result from inhalation, ingestion, or skin contact with contaminated surfaces. Studies were performed in actual indoor environments which showed that semi-volatile chemicals cause not only surface contamination, but biological accumulation. Textiles showed a higher value of contamination than other examined samples, such as food. In order to verify the observed high accumulation in textiles, model experiments were carried out. Results showed the ventilation rate has no effect on the accumulation process on surfaces like textiles. In indoor environments the existence of semi-volatile chemicals leads to an unavoidable exposition of people in it, thereby resulting in a potential chemical burden of indoor pollution.

19652 (DOE/ER/60493—1-Vol.1, pp 288-292) **Errors in exposure variables and their role in obscuring exposure-response relations; the case of indoor exposure to nitrogen dioxide and fine particles.** Lebret, E. (Harvard School of Public Health, Boston, MA). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

To get an impression of the distortion of exposure-response relations that might occur in the data analysis of a practical situation it was decided to simulate the effects of errors of measurement in exposure measures on an imaginary data set. The case of indoor exposure to nitrogen dioxide (NO_2) and fine particles (RSP) and its effect on pulmonary function and respiratory disease was selected for this purpose for the following reasons. First, several epidemiological studies on in issue are currently underway and previous studies have produced conflicting results, which have been linked to problems in measuring exposure. Second, the commonly used exposure surrogates in these studies are subject to both classical and Berkson type of error. Third, more than one independent variable is involved, which limits the possibilities of a analytical approach. Fourth, sufficient data is available from studies on indoor air quality to estimate the nature and degree of error in exposure surrogates. Fifth, both linear and logistic regression techniques are used in these types of studies.

19653 (DOE/ER/60493—1-Vol.1, pp 293-297) **Acute exposure to nitrogen dioxide and pulmonary function.** Goldstein, I.F.; Andrews, L.R.; Lieber, K.; Foutrakis, G.; Kazembe, F.; Huang, P.; Hayes, C. (Columbia Univ. School of Public Health, New York, NY). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

Eleven asthmatic and twelve non-asthmatic women and children were monitored for five days with a portable continuous nitrogen dioxide monitoring instrument held at breathing level before, throughout and following cooking dinner on a gas cooking range. Pulmonary function (FEV_1, FEB/sub 25-75/) and peak flow as well as a tracing of the entire flow curve was monitored before the gas stove was turned on, during a break in cooking, immediately after and an hour after cooking was completed. Details of the study design and the effect of the above described acute exposures to NO_2 on the various measures of pulmonary function in asthmatics and non-asthmatics will be presented.

19654 (DOE/ER/60493—1-Vol.1, pp 298-303) **Association between nitrogen dioxide levels and lower respiratory symptoms in children exposed to unvented combustion sources.** Berwick, M.; Leaderer, B.P.; Stolwijk, J.A.J.; Zagraniski, R.T. (Yale Univ., New Haven, CT). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

A prospective epidemiologic study was carried out for 12 weeks in the winter of 1983 to evaluate the impact of indoor air contaminant levels on respiratory health. A group of 121 children below the age of 13 (59 with unvented kerosene space heaters in the home; 62 without) were enrolled in the study and nitrogen dioxide levels were measured in 93 percent of the subjects homes for one two-week period. When socioeconomic status and history of respiratory illness were controlled, children under the age of seven exposed to 30 micrograms or more per cubic meter of nitrogen dioxide were found to have a risk of reporting lower respiratory symptoms 2.17 times (C.I. 1.69-2.79) that of children who were not exposed. Aspects of our study design, including increased precision of exposure classification and the inclusion of very young children, may explain our findings.

19655 (DOE/ER/60493—1-Vol.1, pp 304-308) **Health effects of indoor NO_2 pollution.** Brunekreef, B.; Fischer, P.; Houthuijs, D.; Remijn, B.; Boleij, J. (Agricultural Univ. of Wageningen, Netherlands). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The potential health effects of indoor NO_2 pollution were investigated in two separate studies in the Netherlands. In these studies, exposure to NO_2 in the home was measured with diffusion tubes. One study was conducted among adult women, one among 6-9 yr old school children. In the adult study, a negative association was found between indoor NO_2 and pulmonary function, but only among non-smokers living in a rural area. No association with respiratory symptoms was found. Among the children, negative but mostly non-significantly associations with pulmonary function and respiratory symptoms were found. A categorical exposure variable (presence of unvented water heater) appeared to be a stronger predictor of respiratory endpoints than the continuous exposure variable in this population.

19656 (DOE/ER/60493—1-Vol.1, pp 463-4467) **Exposure to nitrogen dioxide and tobacco smoke and respiratory health of children.** Houthuijs, D.; Remijn, B.; Brunekreef, B.; de Koning, R. (Agricultural Univ., Wageningen, Netherlands). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The effect of indoor determinants on respiratory health in children was studied. Personal exposure to nitrogen dioxide (NO_2) and the concentrations at home were measured. Exposure to tobacco smoke was assessed with a questionnaire. Pulmonary function of the children was measured at school and the prevalence of Chronic Non-Specific Lung Disease (CNSLD) was established with the WHO-questionnaire. The children had not moved the last 4 years and no changes in gas appliances inside their home had taken place. Exposure to NO_2 was associated with lower pulmonary functions. The prevalence of CNSLD in children living in houses with an unvented geiser was higher than for children living in houses without an unvented geiser. Passive smoking at home was only negatively associated with MMEF. A positive association was found with CNSLD prevalence.

19657 (DOE/ER/60493—1-Vol.1, pp 473-477) **Human exposure to mutagens from indoor combustion sources.** Lewtas, J.; Claxton, L.D.; Mumford, J.L. (Environmental Protection Agency, Research Triangle Park, NC). 1987. NTIS, PC A. Order Number DE88004513/JAW. (CONF-870853—Vol.1).

From INDOOR AIR '87: 4th international conference on indoor air quality and climate; Berlin, F.R. Germany (17 Aug 1987).

The authors have measured human exposure to mutagens, using indoor medium-volume samplers and personal samplers, in targeted field studies of homes in the US. The combustion sources included in these studies were wood stoves, fireplaces, gas appliances, cooking, and tobacco smoking. These studies demonstrate that the presence of environmental tobacco smoke (ETS) consistently results in human exposure to mutagens which are significantly higher than outdoor air or non-smoking indoor spaces. The muta-

genic emission rates from the other indoor combustion sources (e.g., kerosene heaters) as determined in chamber studies are more variable than ETS and are dependent on the combustion source design and operation. Wood stoves and fireplaces result in higher concentrations of mutagens outdoors, which may indirectly influence the concentration of mutagens indoors.

19658 **(DOE/ER/60592—4) Particle deposition in human and canine tracheobronchial casts: Annual progress report.** Cohen, B.S. (New York Univ., NY (USA). Medical Center). 31 Dec 1987. Contract FG02-87ER60592. 25p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004300/JAW.

This work measures deposition patterns and efficiencies of aerosols within realistic, physical models of the tracheobronchial airways of humans and experimental animals over a range of particle sizes from 0.01 to 1.0 μm, for a variety of respiratory modes and rates. Full morphometric and flow distribution measurements were completed on casts of human and canine tracheobronchial airways, which extend from just below the larynx to airways 1 mm in diameter. They show basic similarities in the distribution of airflow, but also species differences which must be considered. The distribution of airflow was measured for minute volumes equivalent to 6, 11, 17 and 22 L min^{-1} for the human and 3, 6, 8 and 11 L min^{-1} for the canine for both constant and pulsatile inspiratory flow. Inertance was found to carry more of the flow to airways of the lower lobes at higher flow rates. Basic differences in airway branching pattern result in a more distinct change in airflow distribution as flow rate changes for the canine cast as compared with the human cast. These differences will contribute to differing patterns of mass transfer of inhaled particles in central airways of the two species. 8 refs., 2 figs., 5 tabs.

19659 **(NP—8751801) Comparison between the growth rates of single beech trees of different degrees of damage.** Athari, S. (Goettingen Univ. (Germany, F.R.). Inst. fuer Forsteinrichtung und Ertragskunde). 1987. 17p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751801/JAW.

The trees within each of three beech stands were classified according to Roloff's damage classification system. Stem analyses were carried out for each of the sample trees and increment cores were extracted from the four nearest neighbours. The results were as follows: 1. The rate of height growth was inversely proportional to the degree of damage. 2. It could be shown that the environment and social position of the sample tree must be considered when assessing the influence of damage on growth. Stand density in the immediate environment of the study tres tended to decrease with increasing damage. The influence of the enlarged growing space on growth may exceed that of damage and thus confound the effect of pollution. 3. In case of equal competition the rate of diameter growth decreases with increasing damage. 4. In beech stands the assessment of damage categories poses serious problems. Roloff's damage categories are based on branching habits, but the results of the classification differ substantially from those based on foliage losses. The characteristics and their interrelationships which describe the crown adequately are complex. Their role in the assessment of damage and for the purpose of damage classification deserves much attention.

19660 **(NP—8751956) Ecotoxicological investigations to quantify the atmospheric acid- and heavy-metal input on the hydrosphere of forest ecosystems. Final report.** Rothe, G.M. (Mainz Univ. (Germany, F.R.). Inst. fuer Allgemeine Botanik; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). May 1986. 67p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751956/JAW.

In experiments the influence of acid nutrient solutions and the influence of Al enriched acidic nutrient solutions on the growth, morphology and physiology of spruce plants was studied. The experimental results obtained are compared to studies on spruce plants growing in forest ecosystems of the densely populated Rhine-Main-area, FRG. Spruce trees in the Rhine-Main-area are injured by both gaseous air pollutants which cause a leaching of Mg and probably a reduction of the carbonhydrate metabolism in the needles and by soil noxes which cause a K-deficiency and a destruction of the roots. With 44 refs., 9 tabs., 16 figs..

19661 **(ORNL—6409) Water quality criteria for colored smokes: Solvent Green 3: Final report.** Davidson, K.A.; Hovatter, P.S. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 96p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE88003303/JAW.

The available data on the environmental fate, aquatic toxicity, and mammalian toxicity of Solvent Green 3, an anthraquinone dye used in colored smoke grenades, were reviewed. The US Environmental Protection Agency (USEPA) guidelines were used in an attempt to generate water quality criteria for the protection of human health and of aquatic life and its uses. Sufficient data to determine the toxicity of Solvent Green 3 in freshwater aquatic organisms are lacking. The 96-hr TL_{50} for Pimephales promelas is >100 mg/L. Solvent Green 3, at a concentration of 10 mg/L, causes a transient reduction in growth of the green alga Selenastrum capricornutum. No data are available concerning the chronic toxicity or bioaccumulation of Solvent Green 3 in aquatic organisms. No data are available on any of the toxicity parameters for Solvent Green 3 in humans. No data on the pharmacokinetics of Solvent Green 3 administered orally in laboratory animals are available. Solvent Green 3 has a low order of toxicity whether administered by the oral, dermal, or inhalation route. The acute oral LD_{50} is >3.16 g/kg in rats, but may be as high as 15 g/kg, >1 g/kg in dogs, and 10 g/kg in rabbits. Sufficient pertinent data were not available for deriving a water quality criterion for the protection of human health. 83 refs., 3 figs., 10 tabs.

19662 **(ORNL—6410) Water quality criteria for colored smokes: 1,4-diamino-2,3-dihydroanthraquinone: Final report.** Davidson, K.A.; Hovatter, P.S.; Ross, R.H. (Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 70p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004328/JAW.

The available data on the environmental fate, aquatic toxicity, and mammalian toxicity of 1,4-diamino-2,3-dihydroanthraquinone (DDA), and anthraquinone dye used in violet-colored smoke grenades, were reviewed. The US Environmental Protection Agency (USEPA) guidelines were used in an attempt to generate water quality criteria for the protection of human health and of aquatic life and its uses. DDA will readily oxidize to 1,4-diaminoanthraquinone (DAA) in air or during combustion of the smoke grenade. The dye is insoluble in water; however, no information is available concerning its transformation or transport in soil, water, and sediments. No data are available concerning the toxic effects of DDA in aquatic organisms; therefore, a Criterion maximum Concentration and a Criterion Continuous Concentration cannot be determined. Toxicity studies following the USEPA guidelines are recommended. DDA is a weak mutagen in the Salmonella Reversin Assay, but the combustion or oxidation product, DAA is a strong mutagen in the same test. Violet smoke is noncarcinogenic in the SENCAR Mouse Skin Tumor Bioassay. 63 refs., 1 fig., 3 tabs.

19663 **(PB—88-125695/XAB) Transplanation and chromosomal analysis of cell lines derived from mesotheliomas induced in rats with erionite and UICC chrysotile asbestos.** Palekar, L.D.; Eyre, J.F.; Coffin, D.L. (Northrop Services, Inc., Research Triangle Park, NC (USA)). Oct 1987. 16p. NTIS, PC A03/MF A01.

The histological lesions, chromosomal characteristics and transplantability of six erionite-induced and seven UICC chrysotile-induced rat mesotheliomas are compared. The tumors were of four types: tubulopapillary, fibrosarcomatous, mixed fibrosarcomatous and tubulopapillary and mixed fibrosarcomatous and chondrosarcomatous. Cells lines derived from these displayed heterogeneous chromosome anomalies, but none were unique either to chrysotile or erionite treatment. Five of seven erionite-induced and four of six UICC chrysotile-induced tumors had various anomalies of chromosome No. 1. When seven cell lines were transplanted into syngeneic rats, all produced tumors that were pathologically similar to the original tumor regardless of the route of injection. Cytogenetically, the cell lines derived from tumors after intrapleural transplantation resembled the injected cell line.

19664 **(PB—88-129218/XAB) Sulfur dioxide-induced bronchoconstriction in asthmatics exposed for short durations under controlled conditions: a selected review.** Horstman, D.H. (Environmental Protection Agency, Research Triangle Park, NC (USA). Health Effects Research Lab.). Nov 1987. 31p. (EPA—600/D-87/333). NTIS, PC A03/MF A01.

Prior to 1980, essentially no health related effects had been observed for short-term (< 1 hr) exposures to sulfur dioxide (SO_2) levels similar to those found in the ambient environment (= or < 1 ppm). In 1980 and 81, the results from several studies indicated that asthmatics' airways were substantially more responsive to SO_2 than those of nonasthmatic individuals and that, when combined with moderate exercise, significant bronchoconstriction resulted from exposures to as low as 0.5 ppm SO_2. Since then, a multitude of reports regarding short-term exposure of asthmatics to low SO_2 levels have appeared in the literature. From these studies, reflex bronchoconstriction, mast cell degranulation and other, yet unidentified, mechanisms were implicated in the induction of response. A broad range of responsiveness to SO_2 exists within the asthmatic population. Precise knowledge of factors involved in this variable responsiveness is lacking; differences in nonspecific airway sensitivity and severity of disease are suggested.

19665 **(PNL-SA—14564) Quantitative determination of polycyclic aromatic hydrocarbon adducts to deoxyribonucleic acid using GC/MS [gas chromatography/mass spectrometry] techniques.** Bean, R.M.; Thomas, B.L.; Chess, E.K.; Pavlovich, J.G.; Springer, D.L. (Pacific Northwest Lab., Richland, WA (USA); Oregon Univ., Eugene (USA)). Feb 1988. Contract AC06-76RL01830. 11p. (CONF-870940—3). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005523/JAW.

From 11. international symposium on polynuclear aromatic hydrocarbons; Gaithersburg, MD, USA (23 Sep 1987).

A direct, specific mass spectrometric method useful for determination of polycyclic aromatic adducts has been developed. Our experiments indicated that overall recoveries from the acid hydrolysis, isolation and derivatization steps will be about 50%. It is apparent that a method even for BaP adducts is not yet complete. The methods described in this paper are provided in detail. Other derivatization techniques are needed that are selective and quantitative, and that will enhance the singal in the mass spectrometer to improve instrument selectivity and sensitivity. In addition to improvements in instrument sensitivity and gas chromatography column performance, there is a great need for procedures for rigorous documentation of organic analytical methods at the picogram level. 12 refs., 2 tabs.

19666 **(UCRL—21007) Health risk assessment of trichloroethylene (TCE) in California drinking water.** Bogen, K.T.; Hall, L.C.; Perry, L.; Fish, R.; McKone, T.E.; Dowd, P.; Patton, S.E.; Mallon, B. (Lawrence Livermore National Lab., CA (USA)). 28 Jan 1988. Contract W-7405-ENG-48. 302p. NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE88005364/JAW.

This document presents an assessment of the potential health risks associated with exposure to trichloroethylene (TCE) dissolved in California drinking waters. This assessment is being provided to the California Department of Health Services (CDHS) for the development of drinking-water standards to manage the health risks of TCE exposures. Other assessments required in the risk-management process include analyses of the technical and economic feasibility of treating water supplies contaminated with TCE. A primary goal of this health-risk assessment is to evaluate dose-response relationships for observed and potential toxic end points of TCE in order to define dose rates that can be used to establish standards that will protect members of the general public from adverse health effects resulting solely from water-based exposures to TCE. We also analyze the extent of human exposures attributable to TCE-contaminated groundwater in California. 363 refs., 8 figs., 22 tabs.

19667 **(UCRL—97594) Tetrachloroethylene metabolism resulting from domestic respiratory exposure: Pharmacokinetic considerations relevant to risk assessment.** Bogen, K.T.; McKone, T.E. (Lawrence Livermore National Lab., CA (USA)). Oct 1987. Contract W-7405-ENG-48. 19p. (CONF-871188—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003954/JAW.

From Annual meeting of the Society for Risk Analysis; Houston, TX, USA (1 Nov 1987).

Physiologically based pharmacokinetic (PBPK) models describing the uptake, metabolism, and excretion of xenobiotic compounds are now proposed for use in regulatory health-risk assessments. In this study we compare how different scenarios for domestic respiratory exposure to tetrachloroethylene (PCE) from ground water influence the extent of PCE metabolism predicted using a PBPK model. Indoor exposure patterns we use as input to the PBPK model are realistic ones generated from a three-compartment model describing volatilization of PCE from domestic water into household air. Values we use for the metabolic parameters of the PBPK model are estimated from data on urinary metabolites in workers exposed to PCE. For respiratory PCE exposure due to typical levels of PCE in ground water, use of time-weighted average air concentrations with a steady-state PBPK model yields estimates of total metabolized PCE similar to those obtained using completely dynamic modeling, despite considerable uncertainty in key exposure and metabolic-model parameters. These findings suggest that, in this case, risk estimation taking pharmacokinetics into account may be accomplished using simple analytic methods. 31 refs., 8 figs., 3 tabs.

19668 **Short-term effects of polynuclear aromatic hydrocarbons on sea-surface microlayer phytoneuston.** Riznyk, R.Z.; Hardy, J.T.; Pearson, W.; Jabs, L. (Battelle/Marine Research Lab., Sequim, WA). *Bulletin of Environmental Contamination and Toxicology;* **38**: No. 6, 1037-1043(Jun 1987). Contract AC06-76RL01830.

The Puget Sound area, in the state of Washington, is characterized by an increasing population reflected by the growth of Seattle and Tacoma and their respective industrial-based economies. Previous work on the sea-surface microlayer of Puget Sound has shown that contaminant metals and organics are present at some sites at concentrations from 10 to more than 1000 times greater than in underlying sea water. Since the sea-surface microlayer may contain an inordinately high concentration of PAHs relative to the water column, the authors decided to investigated the short-term effect of these hydrophobic contaminants on phytoneuston community dynamics under controlled in situ conditions during this summer season when bloom conditions can prevail in areas of Puget Sound.

19669 **Relationship of drinking water disinfectants to plasma cholesterol and thyroid hormone levels in experimental studies.** Revis, N.W.; McCauley, P.; Bull, R.; Holdsworth, G. (Oak Ridge Research Institute, TN). *Proceedings of the National Academy of Sciences of the United States of America;* **83**: No. 5, 1485-1489(Mar 1986).

The effects of drinking water containing 2 or 15 ppm chlorine (pH 6.5 and 8.5), chlorine dioxide, and monochloramine on thyroid function and plasma cholesterol were studied because previous investigators have reported cardiovascular abnormalities in experimental animals exposed to chlorinated water. Plasma thyroxine (T4) levels, as compared to controls, were significantly decreased in pigeons fed a normal or high-cholesterol diet and drinking water containing these drinking water disinfectants at a concentration of 15 ppm (the exception was chlorine at pH 6.5) for 3 months. In most of the treatment groups, T4 levels were significantly lower following the exposure to drinking water containing the 2 ppm dose. Increase in plasma cholesterol were frequently observed in the groups with lower T4 levels. This association was most evident in pigeons fed the high-cholesterol diet and exposed to these disinfectants at a dose of 15 ppm. The factor(s) associated with the effect of these disinfectants on plasma T4 and cholesterol is not known. The authors suggest however that these effects are probably mediated by products formed when these disinfectants react with organic matter in the upper gastrointestinal tract.

5604 Other Environmental Pollutant Effects

REFER ALSO TO CITATION(S) 19111

19670 **(PNL-SA—15028) Reduction of the nocturnal rise in pineal melatonin levels in rats exposed to 60-Hz electric fields in utero and for 23 days after birth.** Reiter, R.J.; Anderson, L.E.; Buschbom, R.I.; Wilson, B.W. (Pacific Northwest Lab., Richland, WA (USA); Texas Univ., San Antonio (USA). Health Science Center). Feb 1988. Contract AC06-76RL01830. 6p. (CONF-8709165—2). NTIS, PC A02. Order Number DE88005684/JAW.

From International workshop on the pineal gland and cancer; Tubingen, F.R. Germany (8 Sep 1987).

Rats exposed to 60-Hz electric fields of either 10, 65, or 130 kV/m from conception to 23 days of age exhibited reduced peak nighttime pineal melatonin contents compared to unexposed controls. As a group, the exposed rats also exhibited a phase delay, estimated at approximately 1.4 hours, in the occurrence of the nocturnal melatonin peak. No clear dose-response relationship was noticed over the range of electric field strengths used as treatments in these experiments. These are the first studies concerned with the effects of electric field exposure on the pineal melatonin rhythm in immature rats and the findings are generally consistent with those obtained using adult rats, where electric field exposure has been shown to abolish the nighttime rhythm in pineal melatonin concentrations. 15 refs., 1 fig., 1 tab.

19671 **Experimental radiation physics and implications for radiobiology.** Dehmer, J.L. (Argonne National Lab., Argonne, IL 60439). pp 115 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—). Contract W-31-109-ENG-38.

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

Recent advances in laser photophysics and photochemistry make it possible to examine fundamental radiological mechanisms which formerly lay beyond our grasp. In particular, it is now possible to selectively prepare single excited states of isolated molecules and to study their physics and chemistry at the quantum-state-specific level, all on time scales from microseconds down to femtoseconds. An overview of the scientific prospects in this field and some examples of phototypical studies are used to convey the potential impact of these advances on our understanding of the physical and early chemical stages of radiation effects.

57 HEALTH AND SAFETY

REFER ALSO TO CITATION(S) 19562

19672 **(SAND—87-2615) Characteristics of the positive lighting flash.** Fisher, R.J. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005854/JAW.

This report summarizes and documents the available data on key positive lightning parameters such as peak channel current, rise times and rise rates, continuing currents, and overall charge transfer. While the body of existing data in this area was found to be relatively sparse, it is generally consistent and indicates positive flash distributions with average values of peak currents in excess of those of negative ground flashes by about 50%. In comparison with those of negative ground flashes, these distributions are broader and are weighted by numbers of more severe flashes. Positive flashes very often combine long stroke current decay times with high level continuing currents to produce extraordinary stroke charge transfers of 300°C or more. Peak currents as high as 400 kA have been reported, a factor of 2 greater than the accepted one percentile level severe negative flash amplitude. Averaged over all factors (geographic, seasonal, ans storm phase), positive flashes constitute between 10 to 20% of all ground flashes. Under certain circumstances, however, up to 100% of all observed flashes in given storms and storm phases are positive. Key areas of uncertainty include (1) the frequency of occurrence of the more severe positive flashes, (2) definition of the details of the severe continuing currents which have been found to accompany over 60% of all such flashes, and (3) the distribution of the current derivatives associated with the fast transition portion of the return stroke current front. Recommendations are given for possible practical research efforts addressing each of these data gaps. 4 figs., 6 tabs.

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 17800, 17801, 19097, 19688

19673 **(DOE/ER—0354) Contrasting hydrologic processes on semiarid and humid watersheds.** Cundy, T.W. (Washington Univ., Seattle (USA)). Dec 1987. 16p. (CONF-870957—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004128/JAW.

From Remote fluvial experiments (REFLEX) investigators' meeting; Newark, DE, USA (14 Sep 1987).

This seminar compared and contrasted hydrologic processes and the applicability of remote sensing in solving hydrolgic problems on humid and semiarid watersheds. In meeting this goal the seminar also clarified some of the major challenges facing the REFLEX program' a principal one being the ability to utilize remote sensing information and field hydrologic data to move from one spatial scale to another. If REFLEX can provide even a small step toward accomplishing this it would be a major contribution in theoretical and applied hydrology. 2 refs., 4 figs., 1 tab.

19674 **(DOE/ER/60013—T1) Polar Research Board annual report, 1986 and future plans.** (National Research Council, Washington, DC (USA). Polar Research Board). 1987. Contract FG01-81ER60013. 66p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004543/JAW.

This annual report describes the Polar Research Board, its origin and objectives, its work and plans, and its principal activities and accomplishments during calendar year 1986. The report presents a summary of the various aspects of the Board's program and of its responsibilities as US National Committee for the Scientific Committee on Antarctic Research (SCAR) of the International Council of Scientific Unions. 145 refs., 3 figs.

19675 **(DOE/NV/10322—27) Geologic report: Lithology and stratigraphy of drill holes completed during 1987 in LANL use areas of Yucca Flat, Nevada Test Site: Volume 9.** Thompson, P.H.; Drellack, S.L. Jr. (Fenix and Scisson, Inc., Mercury, NV (USA)). Jan 1988. Contract AC08-84NV10322. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005519/JAW.

This report is a compilation of data from drill holes completed during the calendar year 1987 in areas used by Los Alamos National Laboratory in Yucca Flat, Nevada Test Site. Data presented in this report include hole locations and other pertinent physical data; lithologic descriptions and stratigraphy for each hole; a graphic presentation for each drill hole illustrating lithology, stratigraphy and the corresponding response of selected geophysical logs. Included also are supplemental data unique to each drill hole. Lithologic description and stratigraphic identification of the Tertiary volcanic rocks are emphasized.

19676 **(DOE/SR/15160—1) Geohydrologic investigation and establishment of a permanent multi-observational well network in Aiken, Allendale, and Barnwell Counties, South Carolina: Phase 1.** Logan, W.R. (South Carolina Water Resources Commission, Columbia (USA). Geology-Hydrology Div.). Oct 1987. Contract FC09-86SR15160. 74p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88003517/JAW.

This project was initiated to gather high-quality geologic and hydrologic data that could be correlated with data being obtained at Savannah River Plant (SRP) and in other areas of the State. A total of 1926 linear feet of continuous coring was attempted, with a resulting recovery of 84%. Detailed lithologic descrip-

tions were prepared in the field by SCWRC geologists. Formational picks were made on the basis of these descriptions and geophysical-log interpretations. The core samples have been re-described both macroscopically and microscopically in the laboratory to verify data concerning color, mineralogy, grain size, roundness, and fossil content. Selected samples of the cores will be collected for fossil-pollen age dating. Various other age dating techniques will be used, including macro fossil identification and the rubidium-strontium ratio method. The data collected as part of this program will aid the geologic community in revising the much-debated stratigraphy in this area of the State.

19677 **(DP-MS—87-121) Subsurface structures in the southwestern Coastal Plain of South Carolina.** Fallaw, W.C.; Price, V. Jr. (Furman Univ., Greenville, SC (USA). Dept. of Geology; Savannah River Lab., Aiken, SC (USA)). 1987. Contract AC09-76SR00001. 22p. (CONF-871014—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000791/JAW.

From Annual meeting of the Geochemical Society; Phoenix, AZ, USA (25 Oct 1987).

Many cored monitoring wells have been drilled on the Savannah River Plant, located in the updip part of the Coastal Plain in Aiken and Barnwell Counties, South Carolina. In one part of the plant, 47 wells within an area of about 4 mi/sup 2/ (10.2 km/sup 2/) provide a large amount of control for subsurface mapping. Paleontological data and regional correlation indicate that the strata in the study area are upper Cretaceous, lower Paleocene, lower middle Eocene, upper middle Eocene, upper Eocene, and Miocene(?). The units appear to be separated by unconformities. Structure-contour mapping of these time-rock units reveals the presence of crudely anticlinal and synclinal structures trending northwest-southeast. Structural relief is about 70 ft (21 m) on the upper Cretaceous horizon and generally decreases going up the stratigraphic section. The sequence of events for each unit is development of an irregular erosion surface during a time of low sea level; deposition of the succeeding unit at a time of high sea level; differential compaction of the unit causing greater subsidence over topographic lows on the unconformity and less subsidence over the topographic highs; and modification of the upper surface of the unit during the next time of low sea level. 12 refs., 9 figs.

19678 **(ORNL—5849) HYSPAC: Simulating hydraulic flow in spatially correlated soils.** Ward, R.C.; Luxmoore, R.J.; Yeh, G.T. (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 150p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88004769/JAW.

This report presents the development of a set of interactive computer codes referred to as HYSPAC for Simulating HYdraulic flow in SPAtially Correlated soils. The set of codes was developed from MATTUM [A Multidimensional Model for Simulating Moisture and Thermal Transport in Unsaturated Media]. The mathematical basis for the simulation code is explaind, and a specific example of a five-layer soil grid is presented. The average soil properties, hydraulic conductivity, and water retention are these measured in Fullerton soil. The use of spatial correlograms to describe soil variability is explained, and results of several example applications of the HYSPAC code are presented. 108 refs., 12 figs., 7 tabs.

5802 Geophysics

REFER ALSO TO CITATION(S) 18248, 18251, 19099

19679 **(AD-A—185959/4/XAB) Technical report for the period 1 April-30 June 1987.** Baumstark, R.; Campanella, A.; Dysart, P.; Israelsson, H.; Jurkevics, A. (Science Applications International Corp., Arlington, VA (USA). Center for Seismic Studies). Aug 1987. 03p. (SAIC—87/1131). NTIS, PC A02/MF A01.

Two technical notes related to network capability and design are presented. One compares mean values of short-period seismic noise measured during the GSE Technical Test with published values of Ring-dal for stable and tectonically active regions. A second compares depth determinations during the 1980 Common Data Base Experiment with theoretical detection thresholds. The third considers the significance of local and regional data in a global monitoring system. Two reports on research to improve analysis of regional seismic data. One is based on a consideration of particle motion of regional phases, and recommends ways to implement automated or interactive particle-motion analysis of regional seismic waveforms. The other focuses on event characterization of 95 earthquakes, mine blasts, and offshore events recorded at NORESS. Miscellaneous topics deal with azimuth determination using polarization parameters of P and LR waves; reanalysis of sub b bias between a recording site in eastern Kazakh and a station on and a new database containing waveforms from stations being operated in eastern Kazakh under an agreement between the Soviet Academy of Sciences and the Natural Resources Council.

19680 **(AD-A—185968/5/XAB) NORSAR (Norwegian Seismic Array) detection processing system. Semiannual technical summary report, 1 October 1986-31 March 1987.** Loughran, L.B. (Royal Norwegian Council for Scientific and Industrial Research, Kjeller). 31 May 1987. 131p. (NORSAR-SCIENTIFIC—2-86/87). NTIS, PC A07/MF A01.

This Semiannual Technical Summary describes the operation, maintenance and research activities at the Norwegian Seismic Array (NORSAR). Investigations into further potential improvements in the NORSAR array processing system have continued. A new Detection Processor (DP) program was developed and tested in an off-line mode. This program is flexible enough to conduct both NORSAR and NORESS detection processing as is done today, besides incorporating improved algorithms. A wide-band slowness estimation technique was investigated by processing data from several events from the same location. Ten quarry blasts at a dam construction site in western Russia and sixteen Semipalatinsk nuclear explosions were selected. The major conclusion from this study is that employing a wider frequency band clearly tends to increase the stability of the slowness estimates, provided the signal-to-noise ratio is adequate over the band of interest. The stability was found, particularly for Pn, to be remarkably good for the western Norway quarry blasts when using a fixed-frequency band for each phase for all ten events.

19681 **(CONF-880140—1) Geophysical diffraction tomography for imaging isolated subsurface inclusions.** Witten, A.J.; King, W.C. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Civil and Environmental Engineering). 1988. Contract AC05-84OR21400. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003918/JAW.

From Tunnel detection symposium; Golden, CO, USA (12 Jan 1988).

This paper reports on the progress in developing a fieldable geophysical diffraction tomography system, including the development of a data acquisition system capable of resolving the necessary wave characteristics, in-field real time signal processing, and image reconstruction software development. Geophysical diffraction tomography is a technique for high resolution, quantitative imaging of subsurface cross-sections. The method is based upon an imaging process known as filtered backpropagation which is a generalization of the inverse straight ray tracing process referred to as backprojection. In backpropagation, an image of the spatial variations in refractive index is formed by backpropagating, by means of the reduced wave equation, data received along an array of detectors from this array into the support volume of the host medium. Important steps in this imaging process include the synthesis of a coherent incident wave, the determination of complex phase perturbations relative to a homogeneous background, and the numerical application of a holographic lens. Using a seismic signal this method is capable of detecting and imaging subsurface features possessing material properties different from the surrounding medium. 14 refs., 5 figs.

19682 (IAE—4247/1) Radioactive emanations in fumarole gases of a series of volcanoes in Kamchatka. Adamchuk, Yu.V.; Firstov, P.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 29p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703198/JAW.

The results of measurements of volume activity of emanations in fumarole gases of a series of acting volcanoes in Kamchatka during 1980-1983 are presented. The value of radon concentration in Avachinski volcano fumaroles equal — 2 emanes did not change substantially as compared with the data for 1966. The highest activity (11.5+-0.4 emanes) is registered in the Bezymyannyj volcano fumaroles. The emanation site survey of fumarole fields of the second cone of the Great fractured Tolbachinski eruption (GFTE) revealed the narrowly localized zone of radioactive emanation emissions. The radon emission in the above zone in 1981 constitutes $(2.3 +- 0.4)x10^{-6}$ Ci/s. Using this estimation, time (34-42 days) and average rate (2.5-3.0 m/h) of depth gases hoisting from magmatic focus are calculated as well as filtration rock characteristics in the narrowly localized near-mouth zone of the second cone of GCTE North outburst in the post eruptive period: permeability coefficient (0.1-4.3 darci), porosity (3-15 %) and mean value of cracks and pores opening $(0.6-2.0)x10^{-3}$ cm). The characteristic values found proved to be compared with parameters of crushing zone near epicenters of underground nuclear explosions. 34 references, 5 figures.

19683 (LA-UR—87-4129) An efficient simulation model for nuclear geophysical measurements. Wilson, R.D.; Cook, T.K.; Dean, S.H. (Los Alamos National Lab., NM (USA); Highland Scientific Ltd. (USA); Southern Oregon State Coll., Ashland (USA)). 1987. Contract W-7405-ENG-36. 7p. (CONF-8710196—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004306/JAW.

From Minerals and Geotechnical Logging Society symposium; Golden, CO, USA (6 Oct 1987).

Nuclear measurements that provide data related to geophysical parameters have been used for many years in well-logging, surface surveys, and laboratory core studies. The measurement process can be considered in two parts: (1) the transport of nuclear radiation from source to detector; and (2) the interaction of the transported radiation with the detector. For certain measurement problems, the radiation transport of step is not strongly affected by the presence of the detector in step 2. For such problems a simulation approach that decouples radiation transport from detection suggests itself. Many nuclear geophysical measurements can be modeled in this way. This method was first utilized to simulate aerial radiometric surveys and borehole logs for potassium, uranium, and thorium. A one-dimensional deterministic technique was used to model the gamma-ray transport from ground sources and the stoichastic Monte Carlo technique to model the detector response. The results of the two separate simulations are convolved to model a given source and detector combination. The method is an efficient way to model combinations of various radiation transport geometries with differing detector types and sizes. This simulation approach has been extended in the present work to include two-dimensional geometries. The two-dimensional model applies exactly to centralized well-logging tools and in an approximate form for many eccentered measurements. The model is now being used to simulate neutron porosity and gamma-gamma density measurements.

19684 (LBL—23096) A borehole fluid conductivity logging method for the determination of fracture inflow parameters. Tsang, Chin-Fu. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004883/JAW.

It is of much current interest to determine the flow characteristics of fractures intersecting a wellbore to provide data in the estimation of the hydrologic behavior of fractured rocks. The fluid inflow rates from the fractures into the wellbore are important quantities to measure. Often these inflows are at very low rates. One often finds that only a few percent of the fractures identified by core inspection and geophysical logging are water-conducting fractures, the rest being closed, clogged, or isolated from the water flow system. A new procedure is proposed and a corresponding method of analysis developed to locate water-conducting fractures and obtain fracture inflow parameters by means of a time sequence of electric conductivity logs of the borehole fluid. The physical basis of the analysis method is discussed. The procedure is applied to an existing set of data, which shows initiation and growth of nine conductivity peaks in a 900-m section of a 1690-m borehole, corresponding to nine water-conducting fractures intersecting the borehole. We are able to match all nine peaks and determine the flow rates from these fractures. 16 refs., 28 figs., 5 tabs.

19685 (PNL-SA—14800) Regional digital analysis of major crustal structures in Washington State. Beaver, D.E.; Eliason, J.R.; Thiessen, R.L. (Pacific Northwest Lab., Richland, WA (USA); Washington State Univ., Pullman (USA)). Oct 1987. Contract AC06-76RL01830. 28p. (CONF-8708212—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005689/JAW.

From 7. international conference on basement tectonics; Kingston, Canada (17 Aug 1987).

Regional crustal structures within northeastern Washington State have been determined by an analysis of a digital elevation model (DEM). The analysis of the DEM is based on digitally detecting and correlating valleys present in topographic relief. Three-dimensional local planar features are defined that relate to folds, faults, and/or fractures in the crust. The DEM contains an array of surface elevations with a nodal spacing of 154 m. The DEM encompasses the area from 47°45′ to 49° north latitude and 117° to 118°30′ west longitude. Based on structural symmetries, structures determined by the analysis are interpreted to define the current regional stress domains. Analysis of a DEM with a nodal spacing of 30 m has been correlated with the regional DEM analysis. Field measurements of structures in the detailed region verify the predicted stress domain. The crustal structures determined from the DEM analysis are also correlated with mapped structures and Consortium for Continental Reflection Profiling (COCORP) deep seismic reflection traverses. 14 refs., 10 figs., 1 tab.

19686 (UCRL—15975) Barometric pressure transient testing: Analysis methods and solution uniqueness: Final report. Hanson, J.M. (Hanson and Associates, Salt Lake City, UT (USA)). Oct 1987. Contract W-7405-ENG-48. 338p. NTIS, PC A15/MF A01; 1; GPO Dep. Order Number DE88004047/JAW.

Analysis of barometric pressure transients has been shown to be a useful tool in identifying the permeability structure in porous and permeable subsurface formations. The basic approach used in this technique requires monitoring surface barometric pressure fluctuations and the subsurface response to the surface pressure variation at one or more sensor locations over a period of time. These data are then used in conjunction with a given model of the subsurface to extract best estimates of one or more of the model parameters. A number of non-ideal conditions may affect solution uniqueness. These include the existence of noise on the data, sparse subsurface instrumentation, using an incorrect hole-formation model to interpret the data, and the frequency content of the recorded barometric pressure data. All of the work directed toward describing solution uniqueness and parameter uncertainty is presented. Other topics include refinement of several existing formation models, addressing the possibility of extracting an impulse response function from the measured data so that some kind of "type-curve" analysis can be applied, and the usefulness of carrying out the analysis in the frequency-domain. 5 refs., 21 figs., 10 tabs.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 17812

19687 (DOE/ER/13414—12) Activity composition relationships in silicate melts: Annual performance report. Glazner, A.F. (North Carolina Univ., Chapel Hill (USA)). [1987]. Contract FG05-85ER13414. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004721/JAW.

Work performed during the first two years of this project includes construction of furnace laboratory and calibration of instruments, installation of an electron microprobe, and determination of

phase equilibria along a basalt-rhyolite mixing line. This latter study comprises the bulk of work performed to date. We completed approximately 100 experiments on the one-atmosphere phase equilibria of balalt-rhyolite mixtures. Starting materials were an alkali basalt from Pisgah Crater, California, and a high-silica rhyolite from the Bishop Tuff, Owens Valley, California. These materials were chosen because the compositional trend of the mixtures mimics many continental calc-alkaline suites. 5 figs.

5804 Geochemistry

REFER ALSO TO CITATION(S) 17675

19688 **Terminal Ordovician extinction: geochemical analysis of the Ordovician/Silurian boundary, Anticosti Island, Quebec.** Orth, C.J.; Gilmore, J.S.; Quintana, L.R.; Sheehan, P.M. (Los Alamos National Lab., NM). *Geology;* **14**: No. 5, 433-436(May 1986).

Elemental abundances (including Ir), carbon and oxygen ratios in carbonates, mineral content, and thin sections have been measured in samples collected across the conodont-defined Ordovician/Silurian (O/S) boundary exposed on Anticosti Island, Quebec. The Ir concentrations ranged from 5 to a maximum at the boundary of 58 parts per trillion (ppt). However, there is no evidence, on the basis of these Ir results, for the association of a large-body-Earth impact with the O/S extinction, because the Ir concentrations, like those of most other trace elements, are simply proportional to the clay (Al) content in the carbonate sequence. The $^{13}C/^{12}C$ and $^{18}O/^{16}O$ ratios decrease abruptly at the boundary, then just as abruptly increase to a long period of higher than preboundary ratios. These patterns are probably related to the salinity in the seaway, which was shallowing up to boundary time and then deepened and developed patch-reefs. Fresh-water input from rivers would have been most influential during the shallow-water conditions. 32 references, 4 figures.

5805 Oceanography

REFER ALSO TO CITATION(S) 17818, 17819, 17820, 17821, 17822, 17823, 17824, 17825, 17826, 17827, 17828, 17829, 17830, 17831, 19332, 19674

19689 **(DOE/ER/60353—3) Biological processes in the water column of the South Atlantic Bight: Phytoplankton response: A three-year progress report.** Verity, P.G.; Yoder, J.A. (Skidaway Inst. of Oceanography, Savannah, GA (USA)). 1 Dec 1987. Contract FG09-85ER60353. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003848/JAW.

This project report consists of published and unpublished manuscripts which describe research studies initiated and completed during the past three years. Results of these and additional efforts, presently being prepared for submission to refereed journals, were presented at various scientific meetings. SPREX was an interdisciplinary study of the spring removal period when low salinity nearshore waters advect offshore in the region between Savannah and Cape Fear. Our objectives were to determine the fate of the relatively high concentrations of phytoplankton biomass within low salinity nearshore waters and to determine the effect of wind events on phytoplankton dynamics within the nearshore zone. All field studies are complete, and a workshop was held in March 1986 to provide a forum for all investigators to discuss and interpret the results. Several related studies on plankton dynamics in coastal and shelf waters are in progress. A new component, research on the abundance, distribution, and impact of protozoan grazers, was added to this project in 1986 to 1987. Data collection in the nearshore program (BIOTRANS) is nearing completion. Synthesis and analysis of data are in progress. Research on shelf processes includes two components: interdisciplinary shipboard efforts (FLEX) and studies of CZCS satellite imagery of chlorophyll distributions. 6 figs., 1 tab.

19690 **(DOE/ER/60355—3) Circulation and exchange processes on the South Atlantic Bight Continental Shelf: Progress report, July 1, 1987 to June 30, 1988.** Lee, T.N. (Miami Univ., FL (USA). Div. of Meteorology and Physical Oceanography). Dec 1987. Contract FG05-85ER60355. 33p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88003330/JAW.

This report describes an investigation of the physical processes regulating the transport and exchange of materials in the shelf waters. The objective is to improve the capability for prediction of the physical environment. The principal scientific task is to determine the relative importance of the forces driving shelf circulation and exchange and to measure the shelf waters' response over variable time and space scales. The influence of physical processes on chemical and biological distributions and their interactions is studied through interdisciplinary investigations, joint analysis and interpretation of data and joint publications. 128 refs.

19691 (SAND—86-2527, pp F1-F12) **Radiochemical studies at the Nares Abyssal Plain: field studies, November 15.** Livingston, N.D.; Supprenant, L.D.; Clarke, W.R. (Woods Hole Oceanographic Institution, MA). May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

This report is limited to an account of the sample collection activities on this cruise and does not include any shore-based analytical results - since these analyses were postponed indefinitely because of the program termination decision. The objectives were as follows: (1) To deploy and test newly developed wire-deployed in-situ pumping systems for particle and soluble actinide collection. (2) To test and evaluate the performance of different filters and chemisorber systems (for both actinide and cesium isotope collection). (3) To collect a series of samples at different depths to obtain more detailed information on the distribution of fallout radionuclides at depths not sampled in 1984 - to enable more definition of various features of the profiles. (4) To deploy prototype passive chemical monitors (PCM) on the Nares-3 mooring set by the Oregon State University group.

19692 (SAND—86-2527, pp G1-G4) **Nares Abyssal Plain sediment flux studies, FY 1986 annual report.** Dymond, J.; Collier, R.W. (Oregon State Univ., Corvallis). May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

On 21 September, 1984, a mooring (NAP-2) was deployed at 23°14.5'N, 64°02.1'W with an approximate bottom depth of 5835 meters. This mooring contained 6 upward looking traps (@ 720, 1420, 2870, 3785, 4770, 5780 meters) and two inverted traps (@ 2900 and 4800 meters). This mooring was successfully recovered on 21 November, 1985. The details of this recovery and the samples are presented. On 22 November, 1985, another shorter trap mooring (NAP-3) was deployed. The mooring was similar in design to NAP-1 and has two normal traps at 750 and 4800 meters and an inverted trap at 4830 meters.

19693 (SAND—86-2527, pp H1-H94) **Radiochemical studies at the Nares Abyssal Plain: natural radionuclide resorts.** Cochran, J.K.; Hirshbert, O.J.; Dornblaser, M. (State Univ. of New York, Stony Brook). May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

Work accomplished during FY 85 on samples of sea water and bottom sediments collected at the Nares Abyssal Plain is described. The authors participated in the November 1985 cruise (EN-137) aboard the R/V ENDEAVOR to the Nares Abyssal Plain. Water samples were collected by in situ pump and by hydrocast. The former were taken for analysis of Th isotopes, Pu and ^{241}Am, but the analyses have not been carried out due to reduc-

tions in funding. The hydrocast samples were taken for in situ radon, and the initial analyses were made aboard the ship. Details on the collection and analysis of samples from the cruise are presented. Sediment studies completed this year involved samples collected in September, 1984 aboard the R/V ENDEAVOR (EN-121) and in February, 1984 by the R/V TYRO.

19694 (SAND—86-2527, pp I1-I6) **Nares III mooring recovery message.** Simpkins, J.; Brooksforce, K. May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

Mooring released at 12:54 3 Nov 86. Required 9 hours to recover in moderate weather, 8' seas, 15 knot winds. Could not hear the releases with the ranging receiver. The releases checked out on deck. RCM at 4800m flooded after 6 months via passthrough and is a total write-off, transmissometer also leaked. The tape is being soaked in fresh water and hopes it can be read. The extra deep transmissometer seems satisfactory.

19695 (SAND—86-2527, pp 21-22) **Summary.** May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

19696 (SAND—86-2527, pp A2-A19) **Overview of Nares Abyssal Plain environmental program planning meeting.** May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

A meeting was held in Albuquerque, NM, on March 14 and 15, 1985, to develop plans for a six-year interdisciplinary research program at the Nares Abyssal Plain and to discuss arrangements for the fall 1985 oceanographic mission to the Nares Abyssal Plain. Participants were provided with copies of a review of available physical oceanographic data for the Nares (Riser, 1985) and a cruise report of the September-October, SNL-sponsored oceanographic mission to the Nares Abyssal Plain. Speakers reviewed in detail the results of the Nares mission and introduced additional biological, physical, and geochemical data relating to the Nares Study Area.

19697 (SAND—86-2527, pp B1-B24) **Nares Abyssal Plain Sediment Flux Studies, FY 1985 Annual Report.** Dymond, J.; Collier, R. (Oregon State Univ., Corvallis). May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

The sediment trap NAP-1 was successfully recovered and the materials have been analyzed for a set of bio- and geochemical components. The trap mooring NAP-2 was deployed and recovered but no analyses have been completed. The bulk fluxes are relatively low at this site and are approximately 50% biogenic and 50% terrigenous. The flux of terrigenous material is very high due to primary atmospheric inputs and horizontal transport of resuspended sediments. The buoyant particle fluxes are also extremely low. The accumulation of material in the sediments reflects the crustal nature of the vertical flux and also shows the normal loss of labile biogenic phases.

19698 (SAND—86-2527, pp C1-C34) **Radiochemical studies at the Nares Abyssal Plain: natural radionuclide results.** Cochran, J.K.; Hirschberg, D.J. (State Univ. of New York, Stony Brook). May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

Samples of sea water, suspended particles, sediment trap material and bottom sediments collected from the Nares Abyssal Plain were analyzed for natural radionuclides. The thorium isotope profiles reflect the sources of each isotope to the oceans. ^{232}Th is not produced in situ but is added to the oceans by rivers and the atmosphere. Most of the ^{232}Th in sea water is associated with particles and dissolved ^{232}Th at Nares is <.02 dpm/1000 kg. Unlike ^{232}Th, ^{230}Th, and ^{228}Th are both produced in situ from decay of soluble ^{234}U and ^{226}Ra, respectively. The production of ^{228}Th is greatest in the near surface and near bottom waters where the activities of ^{228}Ra are greatest. Dissolved and particulate ^{230}Th generally increase with depth to highest values near the bottom. The sediment trap data given show that the specific activity of the radionuclides measured is nearly constant in trap samples collected at any given depth. This is so in spite of variations of a factor of 2-10 in bulk mass fluxes over time. Thus the activity flux is controlled by the bulk flux. The results of excess ^{230}Th determinations on the long (~ 1.8 m) gravity core taken during the 1984 cruise to Nares do not show regular decreases with depth but instead show alternating zones of high activity and low activity. No meaningful accumulation rate can be derived from these results. As much as 170 cm of sediment must have been deposited relatively rapidly, perhaps in series of turbidites separated by poorly defined periods of pelagic sedimentation.

19699 (SAND—86-2527, pp D1-D29) **Radiochemical Studies at the Nares Abyssal Plain: anthropogenic radionuclide results, FY1985 annual report.** Livingston, H.D. (Woods Hole Oceanographic Institution, MA). May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

Analytical work on samples collected in the water column at the Nares Abyssal Plain study site for the Subseabed Disposal Program has been conducted for artificial radionuclides. These samples included large volume water samples, large volume filtered particulates and soluble phase concentrates collected by in-situ electrical pumps and sediment trap samples collected at the Nares-1 mooring. In addition, further radiochemical analyses were completed of the Nares sediment cores for which Pu, ^{137}Cs and ^{210}Pb data were reported previously. New data for surficial ^{241}Am concentrations were obtained.

19700 (SAND—86-2527, pp E1-E78) **Preliminary data report Nares II mooring and baited camera mooring: current meters.** Pillsbury, R.D. May 1987. NTIS, PC A15/MF A01. Order Number DE87009979/JAW.

In Subseabed Disposal Project annual report, FY85 to termination of project: Physical Oceanography and Water Column Geochemistry Studies, October 1984 through May 1986.

Two moorings containing current meters were recovered on the Nares II mission. One was the Nares-II current-meter sediment-trap mooring (23°14.5'N, 64°02.1'W) deployed on the Nares-I mission in September 1984. The second, the baited camera mooring deployed for 53 hours (23°20.1'N, 64°058'W), contained one current meter, 6 m above the bottom. Because of a program funding curtailment, the data has not been completely evaluated.

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6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 19723, 19813, 19871, 19960, 19961, 19964, 20152

19701 (BNL—40745) Trace element analyses of spheres from the melt zone of the Greenland ice cap using synchrotron x ray fluorescence. Chevallier, P.; Jehanno, C.; Maurette, M.; Sutton, S.R.; Wang, J. (Brookhaven National Lab., Upton, NY (USA); Chicago Univ., IL (USA). Dept. of Geophysical Sciences; Institut du Radium, 75 - Paris (France); Centre National de la Recherche Scientifique, 91 - Gif-sur-Yvette (France). Centre des Faibles Radioactivites; Paris-11 Univ., 91 - Orsay (France). Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse). 1987. Contract AC02-76CH00016. 8p. (CONF-860375—4). American Geophysical Union, 2000 Florida Ave., Washington, DC 20009. Order Number TI88005608/JAW.

From Lunar and planetary science conference; Houston, TX, USA (17 Mar 1986).

Synchrotron x-ray fluorescence spectra of unpolished iron and chondritic spheres extracted from sediments collected on the melt zone of the Greenland ice cap allow the analysis of Ni, Cu, Zn, Ga, Ge, Pb, and Se with minimum detection limits on the order of several parts per million. All detected elements are depleted relative to chondritic abundance with the exception of Pb, which shows enrichments up to factor of 500. An apparent anticorrelation between the Ni-content and trace element concentration was observed in both types of spherules. The fractionation patterns of the iron and chondritic spheres are not complmementary and consequently the two iron spheres examined in this study are unlikely to result from the ejection of globules of Fe/Ni from parent chondritic micrometeoroids. 8 figs., 2 tabs.

19702 (CEA-N—2520) Search for underground muons from the direction of Cygnus X-3 in the Frejus detector. Cygnus X-3 at high energies: to be or not to be. Chardin, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). Apr 1987. 176p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87753178/JAW.

The 900 ton Frejus calorimetric detector is described; it comprises one million detection flash and Geiger tubes. The Cygnus X-3 system is described at low energy, and particularly in the X-ray and radio range where its observation is well established. The analysis realized with the data accumulated by the Frejus detector is presented in order to search for muons from the direction of Cygnus X-3. This negative result is compared to that of the other underground experiments. This result is shown to be clearly in contradiction with the observation reported by the NUSEX experiment, in similar experimental conditions. The widely accepted observations from Cygnus X-3 at high energies are reevaluated in a critical review. It is shown that, in all energy ranges above 1 MeV, the observations cannot be considered as convincing. Concerning the satellite based experiments, the positive result reported by the SAS-2 group can be made compatible with the negative result by the COS-B experiment if the gamma-ray background in the vicinity of Cygnus X-3 is reinterpreted. In the domain of atmospheric Cerenkov experiments, it is shown that none of the observations is convincing and that the agreement between these experiments is only superficial. Air shower experiments appear to present important contradictions. It has been proposed that the emission of Cygnus X-3 could be decreasing with a characteristic time of a few years; a more convincing interpretation is proposed. The fact that the source escapes a totally convincing detection with such a regularity is shown to be highly improbable. Finally, the characteristics of experiments which would allow an inambiguous detection of Cygnus X-3 at high energies are reviewed.

19703 (DOE/ER/10774—8) Very high energy gamma ray astrophysics: Progress report, May 1, 1987-February 1, 1988. Lamb, R.G.; Lewis, D.A. (Iowa State Univ. of Science and Technology, Ames (USA)). Feb 1988. Contract AC02-80ER10774. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005821/JAW.

The Whipple observatory Gamma Ray Collaboration has continued to make steady progress in its development of a highly sensitive stereoscopic imaging gamma-ray telescope (known as the HERCULES project). The milestones in this year's development include: the demonstration of the success of the imaging concept with a single camera by the detection of a very weak flux of gamma rays from the Crab Nebula at a high level of statistical significance (7 sigma), the confirmation of our detection of an anomalous pulsed flux from Hercules X-1 in the summer of 1986 by two other groups; this result has serious implications for the mechanism for gamma-ray emission in this binary source. The construction and installation of the new high resolution camera on the 10 m reflector; the realistic simulation of the sensitivity of this camera as well as that of the full HERCULES system was also undertaken. These, and other highlights of this year's program at the Iowa State University and the Smithsonian Astrophysical Observatory, are discussed in this paper. 6 figs.

19704 (PB—88-126768/XAB) Application of L_1 to astronomy. Rousseeuw, P.J. (Technische Hogeschool Delft (Netherlands). Onderafdeling der Wiskunde en Informatica). 1987. 20p. (REPT—87-10). NTIS, PC E03/MF A01.

In astronomy one often has to determine shifts between stellar spectra. For instance, this happens when studying the orbits of binary-star systems, in which the same star may be moving towards us at one point in time, and away from us at another time. The change of velocity may be measured by means of the Doppler effect, which causes the star spectrum to shift to the red or to the blue. To estimate the actual shift between two observed spectra in an automatic way, astronomers have typically used cross-correlation methods or least squares. However, it turns out that these techniques run into trouble in the case of noisy spectra, which occur frequently for hot and luminous stars. For this reason, it is proposed to apply the L_1 approach. The latter method is more robust against inaccuracies in the data, and appears to be very powerful for analyzing complicated spectra. This paper also reports on some experiences connected with the attempt to persuade non-statisticians to adopt an L_1-based method. The last section tries to describe the kind of situations in which the L_1 approach is most useful.

19705 Neutrino pair energy deposition in supernovae. Cooperstein, J.; Van Den Horn, L.J.; Baron, E. (Brookhaven National Lab., Upton, NY; Amsterdam Universiteit, Netherlands; Steward Observatory, Tucson, AZ; New York State Univ., Stony Brook). *Astrophysical Journal;* 321: L129-L132(Oct 1987).

The role of neutrino-antineutrino annihilation (producing an electron-positron pair) in delayed type II supernova explosions is investigated theoretically. The assumptions and analysis of Goodman et al. (1987) are examined in detail, with a focus on the need for a large density gradient at the edge of the neutrinosphere. It is found that the neutrino annihilation mechanism cannot contribute significantly to the energy of the explosion. 12 references.

19706 (AD-A—185906/5/XAB) Estimating the arrival time of solar-flare-initiated shocks by considering them to be blast waves riding over the solar wind. Smart, D.F.; Shea, M.A.; Dryer, M.; Quintana, A.; Gentile, L.C. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 1986. 12p. (AFGL-TR—87-0279). NTIS, PC A03/MF A01.

Pub. in Solar-Terrestrial Predictions, 471-481(1986).

The solar-flare-initiated disturbance is considered as having two separable components. These are: (1) a blast wave initiated by the impulsive release of energy from a solar flare which rides over the (2) preexisting solar wind. The simplified model considers the shock to be initially driven radially from the flare position some distance from the sun. The near sun speed from 1.5 to 2 solar radii is considered to be indicated by the frequency drift rate of the metric Type II radio burst. A rule of thumb seems to be that the shock is driven from its onset until the x-ray-emission power decays halfway to background on a logarithmic scale. After this initially driven phase, the shock then propagates as a blast wave through the interplanetary medium riding over the pre-existing solar wind. A general characteristic of blast waves in the solar wind frame is that the slope of the speed profile is -0.5. We can attempt to predict the arrival time of a disturbance by separating the disturbance speed into two components, an average blast wave speed obtained

by integrating the blast wave equation in the specified direction and the solar wind speed. Adding these two speeds vectorially yields the disturbance speed toward the observation location. Application of these simplified principles, together with assumptions of the shock front shape, enables an estimate to be made of when a solar-flare-initiated shock might reach the earth.

19707 **(AD-A—186057/6/XAB) Asymptotic directions for selecte cosmic-ray stations calculated using the International Geomagnetic Reference Field for 1980.** Shea, M.A.; Smart, D.F.; Gentile, L. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). Jul 1987. 19p. NTIS, PC A03/MF A01.

Pub. in Solar-Geophysical Activity Reports for STIP Interval XV 12-21 February 1984 Ground Level Event and STIP Interval XVI 20 April-4 May 1984 Forbush Decrease, 155-172(Jul 1987).

Asymptotic directions for high-energy solar particles are given for selected cosmic-ray stations. These values were calculated employing the International Geomagnetic Reference Field model for Epoch 1980.0.

19708 **(FEI—1682) New experimental techniques for solar neutrino detection.** Bogatyrev, V.K.; Zubarev, S.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703149/JAW.

New technique for solar neutrino detection in B/sub r/ $^{81}+\nu=$K/sub r/$^{81}+$e reaction is proposed. Low threshold, large cross section, bromine accessibility, possibility to use the facility and Davis methods practically without changing appear to be the advantages of this reaction. It is proposed to detect krypton 81 atoms using low-background mass spectrometer. Long krypton-81 half-life offers a possibility of determining the solar neutrino flux using bromine contained in traps of oil and gas fields. 7 references, 1 table.

19709 **(N—88-12447) Coronal magnetic fields produced by photospheric shear.** Sturrock, P.A.; Yang, W.H. (Stanford Univ., CA (USA)). Oct 1987. 23p. (NASA-CR—181514; NAS—1.26:181514; CSSA-ASTRO—87-17). NTIS, PC A03/MF A01.

The magneto-frictional method is used for computing force free fields to examine the evolution of the magnetic field of a line dipole, when there is relative shearing motion between the two polarities. It found that the energy of the sheared field can be arbitrarily large compared with the potential field. It is also found that it is possible to fit the magnetic energy, as a function of shear, by a simple functional form.

19710 **(PB—88-127543/XAB) Solar-microwave-radiation maps measured at Metsaehovi Radio Research Station in 1978-1979.** Urpo, S.; Pohjolainen, S.; Teraesranta, H. (Metsaehovi Radio Research Station, Kylmaelae (Finland)). 1987. 75p. (SER-A—1). NTIS, PC E04/MF A01.

The Radio Laboratory of the Helsinki University of Technology operates at the Metsahovi Radio Research Station a 14-m-diameter radio telescope. The Cassegrain telescope system can be used at frequencies 10-100 GHz (wavelengths 3 cm - 3 mm). The telescope has been used for solar research irregularly since 1976. Solar mapping with minicomputer-based recordings started in 1978. Measurements include maps of all or part of the Sun, tracking of active regions, and solar-oscillation monitoring. Most of the solar maps have been measured using receivers operating at 22.2 GHz or at 36.8 GHz. The purpose of this report series is to publish at least one map for each of the days when measurements were performed. The volume contains selected maps measured in 1978 and 1979.

19711 **(PB—88-128426/XAB) Solar-Geophysical Data Number 517, September 1987. Part 1 (prompt reports). Data for August, July 1987, and late data.** Coffey, H.E.; McKinnon, J.A. (National Geophysical Data Center, Boulder, CO (USA)). Sep 1987. 118p. (SGD—517-PT-1). NTIS, PC A06/MF A01.

See also PB—88-128434, and PB—88-114368.

Contents include: Detailed index for 1986-1987; Data for August 1987--(IUWDS alert periods (advance and worldwide), Solar-activity indices, Solar flares, Solar radio emission, Stanford mean solar magnetic field); Data for July 1987--(Solar active regions, Sudden ionospheric disturbances, Solar radio spectral observations, Cosmic-ray measurements by neutron monitor, Geomagnetic indices, Radio propagation indices); Late data--(Solar radio emission July 1987, Pioneer XII interplanetary magnetic-field magnitudes, Cosmic-ray neutron monitor Thule June 1987, Geomagnetic indices, Calcium plage data December 1986-January 1987).

19712 **(PB—88-128434/XAB) Solar-Geophysical Data Number 517, September 1987. Part 2 (comprehensive reports). Data for March 1987, and miscellanea.** Coffey, H.E.; McKinnon, J.A. (National Geophysical Data Center, Boulder, CO (USA)). Sep 1987. 39p. (SGD—517-PT-2). NTIS, PC A03/MF A01.

See also PB—88-128426, and PB—88-114376.

Contents include: Detailed index for 1986-1987; Data for March 1987--(Meudon carte synoptique, Solar flares, Solar radio bursts at fixed frequencies, Solar x-ray radiation from GOES satellite, Mass ejections from the sun, Active prominences and filaments); Miscellaneous data -- Mass ejections from the sun February 1987, Interplanetary solar wind IMP 8.

19713 **A classical solution for the solar neutrino puzzle.** Dearborn, D.S.P.; Marx, G.; Ruff, I. (Lawrence Livermore Lab., Univ. of California, Livermore). pp 465-470 of Nuclear beta decays and neutrino. Kotani, T.; Ejiri, H.; Takasugi, E. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8606205—).

From International symposium on nuclear beta decay and neutrinos; Osaka, Japan (11 Jun 1986).

If the mixture of hydrogen and iron is hot enough for an almost complete ionization of iron, and at the same time it is cool and dense enough to produce electron inhomogeneities around the iron ions, then Debye Huckel approximation predicts separation of an iron rich phase from the hydrogen rich phase. The necessary conditions are fulfilled for most of the solar interior. Precipitation of iron reduces the opacity, decreases the central temperature and suppresses the solar flux of energetic neutrinos. For chlorine target, the estimated neutrino signal is decreased with respect to the standard model considerably, for gallium target it remains practically unchanged.

19714 **(CONF-8607121—) Origin and early history of the universe: Proceedings.** (Liege Univ. (Belgium). Inst. d'Astrophysique). 1986. 445p. NTIS (US Sales Only), PC A19/MF A01. Order Number DE88900380/JAW.

From 26. Liege international astrophysical colloquium; Liege, Belgium (1 Jul 1986).

This colloquium explores the blending of particle physics and cosmology and the important theoretical developments resulting from this combination, and the metaphysical and philosophical implications of modern cosmological theory. The proceedings are divided into six sections: quantum cosmology, quantum field theory and cosmology, cosmic inflation, multidimensional cosmological models, classical singularity, and philosophical problems of cosmology. Separate abstracts were prepared for each paper in these proceedings. (DWL)

19715 **(DOE/ER/10587—T6) Particle physics and cosmology: Progress report for period January 1986-January 1988.** Turner, M.S. (Chicago Univ., IL (USA)). Jan 1988. Contract AC02-80ER10587. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004944/JAW.

This paper briefly discusses research at the University of Chicago in the following areas: Supernova 1987a, inflation, cosmic strings, primordial nucleosynthesis, dark matter/structure formation and MSW neutrino oscillations. 22 refs. (LSP)

6402 Atmospheric Physics

REFER ALSO TO CITATION(S) 19707, 19711

19716 (AD-A—185878/6/XAB) MAXIE 1 (Magnetospheric Atmospheric X-ray Imaging Experiment) program. Progress report, 1 July-30 September 1987. Imhof, W.L.; Voss, H.D.; Chinn, V. (Lockheed Missiles and Space Co., Palo Alto, CA (USA). Lockheed Palo Alto Research Lab.). 25 Sep 1987. 7p. (LMSC—0068447). NTIS, PC A02/MF A01.

The satellite flight of the MAXIE-1 (Magnetospheric Atmospheric X-ray Imaging Experiment) instrument is being implemented under ONR (the Office of Naval Research) sponsorship. The MAXIE-1 instrument is being developed as a joint activity of Lockheed, the Aerospace Corporation, and the University of Bergen; much of the Lockheed development was done under the Independent Research Program. Under ONR sponsorship that institution is responsible for managing the program, for providing spacecraft interface requirements, for providing interface electronics for conditioning sensor signals, for developing test software, and for conducting environmental tests needed for flight. This report describes some of the interface activities undertaken in the last three months, including meetings at NOAA and at RCA.

19717 (AD-A—185998/2/XAB) EISCAT (European Incoherent Scatter Radar) electron-density studies. Final report, 17 August 1986-17 August 1987. Burns, C.J.; Hargreaves, J.K. (Lancaster Univ. (UK). Dept. of Environmental Sciences). 8 Sep 1987. 47p. NTIS, PC A03/MF A01.

Study of F-region electron-density irregularities has continued and further runs of the Special Program have been scheduled to coincide with overpasses of the HILAT satellite. Programming improvements have led to more effective analysis of the data from both EISCAT and HILAT observations. Major variations in electrons in electron content are shown to be related to well defined enhancements of electron density. Typical periods range between 35 and 200 seconds, imply spatial structures of 12 to 70 km. These variations would have significant effects on transionospheric radio propagation. Preliminary comparisons were made between EISCAT and HILAT measurements of total electron content. A significant difference between the measurements is observed, the HILAT observations being 2.2 times larger than those derived from EISCAT. The HILAT measurements from the December 1985 appear to be too large. A brief description is given of the first run of the Special Program on the VHF radar.

19718 (AD-A—186110/3/XAB) Electron acceleration by wave processes in the Earth's ionosphere. Technical report (Final), 15 August 1985-31 December 1986. Morales, G.J.; Maggs, J.E. (California Univ., Los Angeles (USA). Dept. of Physics). 31 Dec 1986. 5p. NTIS, PC A02/MF A01.

The nonlinear modification of the electron distribution function caused by the interaction with a resonant electrostatic field is studied analytically using a perturbation analysis. This interaction produces tail heating and for a limited range of parameter values can form a bump in the distribution, which may lead to emission of secondary waves. These results are applied to the ionosphere's F and upper E regions in the context of ionospheric modification experiments using ground-based powerful HF transmitters. An analytic study is made of the second-order modifications produced on the fast tail electron distribution function of a nonuniform plasma subjected to resonant excitation by wave sources. The source models considered can represent excitation by external electromagnetic waves propagating obliquely to the plasma density gradient, mode-conversion of electrostatic whistlers, beat of two transparent electromagnetic waves, and direct conversion from ripples in the density profile.

19719 (AD-A—186237/4/XAB) Holography of the ionosphere at HIPAS. Memorandum report. Knowles, S.H.; Andrews, M. (Naval Research Lab., Washington, DC (USA)). 5 Oct 1987. 30p. (NRL-MR—6084). NTIS, PC A03/MF A01.

The authors were tasked to investigate the Ionospheric Holography Experimental System undergoing development under UCLA auspices at HIPAS including both questions of engineering feasibility and of the validity of interpretation of the results in terms of extracting meaningful information about the ionosphere. The conclusions in this report represent interactions with the U group through approximately mid-September 1986.

19720 (AD-P—005692/9/XAB) Quiet and disturbed plasmasphere. Lemaire, J. (Institut d'Aeronomie Spatiale de Belgique, Brussels). 1987. 7p. NTIS, PC A02/MF A01.

This article is from The Aerospace Environment at High Altitudes and Its Implications for Spacecraft Charging and Communications. Conference Proceedings of the Electromagnetic Wave Propagation Panel Symposium Held in The Hague, The Netherlands on 2-6 June 1986, AD-A185 880, 1-1-1-7.

The plasmasphere and its outer surface, the plasmapause, are described from an observational point of view. The main properties of this inner magnetospheric region are briefly recalled. The dynamical response of the plasmasphere to enhancements of geomagnetic activity has also been considered. The peeling off of the nightside plasma-dayside refilling mechanism is also addressed.

19721 (AD-P—005693/7/XAB) Magnetospheric control of the bulk ionospheric plasma. Sojka, J.J.; Schunk, R.W. (Utah State Univ., Logan (USA). Center for Atmospheric and Space Sciences). 1987. 14p. NTIS, PC A03/MF A01.

This article is from The Aerospace Environment at High Altitudes and Its Implications for Spacecraft Charging and Communications. Conference Proceedings of the Electromagnetic Wave Propagation Panel Symposium Held in The Hague, The Netherlands on 2-6 June 1986, AD-A185 880, 2-1-2-14.

The temperature, composition, and circulation of the high-latitude, ionosphere display a marked variation with altitude, latitude, longitude, universal time, season, solar cycle, and geomagnetic activity. This variation is largely a consequence of the effect that magnetospheric electric fields, particle precipitation, and heat flows have on the ionosphere. At F-region altitudes, the entire ionosphere drifts in response to magnetospheric electric fields, with the horizontal drift generally displaying a two-cell pattern of antisunward flow over the polar cap and return flow at lower latitudes. This ionospheric motion, in combination with downward magnetospheric heat flows and ion production due to energetic-particle precipitation, act to produce interesting ionospheric features such as ion and electron temperature hot spots, plasma blobs, localized ionization troughs, and extended tongue of ionization, and anomalous F-region peak altitudes and densities. The time delay for the ionosphere to respond to changing magnetospheric conditions is a strong function of altitude and can be as long as 3 to 4 hours in the upper F-region. The ionosphere's response to changing magnetospheric conditions are described using a time-dependent high-latitude ionospheric model.

19722 (AD-P—005694/5/XAB) Model for an electromotive-force generator in the magnetosphere: a source of discrete auroral arcs. Roth, M.; Evans, D.S.; Lemaire, J. (National Oceanic and Atmospheric Administration, Boulder, CO (USA). Space Environment Lab.). 1987. 12p. NTIS, PC A03/MF A01.

This article is from The Aerospace Environment at High Altitudes and Its Implications for Spacecraft Charging and Communications. Conference Proceedings of the Electromagnetic Wave Propagation Panel Symposium Held in The Hague, The Netherlands on 2-6 June 1986, AD-A185 880, 3-1-3-12.

Results obtained from solving Maxwell's and Vlasov's equations to obtain the electrical structure of the sheath that separates magnetospheric-particle populations of different densities and temperatures. It is shown that for reasonable magnetospheric plasma populations an electric potential difference of several kilovolts exists across such a boundary. This potential can serve as the necessary EMF for the auroral current circuit. Ths colocation between a magnetospheric plasma boundary and a discrete aurora is a natural consequence of this picture.

19723 (AD-P—005695/2/XAB) Hostile energetic-particle radiation environments in Earth's outer magnetosphere. Baker, D.N.; Belian, R.D.; Higbie, P.R.; Klebesadel, R.W.; Blake, J.B. (Los Alamos National Lab., NM (USA)). 1987. 16p. NTIS, PC A03/MF A01.

This article is from The Aerospace Environment at High Altitudes and Its Implications for Spacecraft Charging and Communications. Conference Proceedings of the Electromagnetic Wave Propagation Panel Symposium Held in The Hague, The Netherlands on 2-6 June 1986, AD-A185 880, 4-1-4-16.

Three types of naturally-occurring, and highly variable, hostile transient particle radiation environments are encountered at, or near, spacecraft geostationary orbits: (1) High-energy protons due to solar flares; (2) Energetic ions and electrons produced by magnetospheric substorms; and (3) Very-high-energy electrons of uncertain origin. In this paper, emphasis is given to highly relativistic electrons (3 to approx. 10 MeV). Electron fluxes and energy spectra are shown that were measured by two high-energy electron sensor systems at 6.6 earth radii frm 1979 - 1984. Large, persistent increases in this population were found to be relatively infrequent and sporadic in 1979-81 around solar maximum. During the approach to solar minimum (1981-present), it is observed that the highly relativistic electrons occur with a regular 27-day periodicity, and are well associated with the re-established solar-wind stream structures. A superposed epoch-analysis technique shows that an energetic-electron enhancement typically rises on a 2- to 3-day time scale and decays on 3- to 4-day time scale at essentially all energies above approx. MeV.

19724 (AD-P—005696/0/XAB) Use of Pi2 pulsations as indicators of substorm effects at geostationary orbit. Lester, M. (Royal Aircraft Establishment, Farnborough (UK)). 1987. 9p. NTIS, PC A02/MF A01.

This article is from The Aerospace Environment at High Altitudes and Its Implications for Spacecraft Charging and Communications. Conference Proceedings of the Electromagnetic Wave Propagation Panel Symposium Held in The Hague, The Netherlands on 2-6 June 1986, AD-A185 880, 5-1-5-9.

The magnetospheric substorm is the most-frequent and perhaps the most-important mechanism of energy exchange over a large volume in the coupled magnetosphere-ionosphere system. This paper reviews some of the characteristics of Pi2 pulsations observed at mid-latitudes on the ground and assess the use of certain characteristics in indicating various magnetic and particle perturbations occurring during substorms. Spacecraft charging and its effects at geosynchronous orbit are also reviewed. Finally, there is a brief discussion of how Pi2 pulsations might be used to predict intervals of spacecraft charging at geosynchronous orbit.

19725 (AD-P—005697/8/XAB) Wave-induced particle precipitation from the magnetosphere and the associated ionospheric perturbations. Inan, U.S. (Stanford Univ., CA (USA). Space, Telecommunications and Radioscience Lab.). 1987. 12p. NTIS, PC A03/MF A01.

This article is from The Aerospace Environment at High Altitudes and Its Implications for Spacecraft Charging and Communications. Conference Proceedings of the Electromagnetic Wave Propagation Panel Symposium Held in The Hague, The Netherlands on 2-6 June 1986, AD-A185 880, 6-1-6-12.

A brief review of the gyroresonant wave-induced precipitation of energetic radiation belt particles is presented, using the particular case of interactions involving lightning-generated whistler waves as an example. The interaction physics is first discussed in the context of results from a recently developed theoretical model of the whistler-particle scattering process occurring in the magnetosphere. This is followed by a discussion of the Trimpi effect, a particularly sensitive ground-based technique that has recently been increasingly used for detecting ionospheric perturbations produced by whistler-induced energetic particle precipitation from the magnetosphere on L-shells of 2-5.

19726 (AD-P—005700/0/XAB) Electron beam experiments at high altitudes. Olsen, R.C. (Alabama Univ., Huntsville (USA). Dept. of Physics). 1987. 8p. NTIS, PC A02/MF A01.

This article is from The Aerospace Environment at High Altitudes and Its Implications for Spacecraft Charging and Communications. Conference Proceedings of the Electromagnetic Wave Propagation Panel Symposium Held in The Hague, The Netherlands on 2-6 June 1986, AD-A185 880, 10-1-10-8.

Experiments with the electron gun on the SCATHA satellite produced evidence of beam-plasma interactions, and heating of the low-energy electrons around the satellite. These experiments were conducted near geosynchronous orbit, in the dusk, bulge, and plasma sheet, with one short operation in the lobe regions, providing a range of ambient plasma densities. The electron gun was operated at 50 eV, with beam currents of 1, 10, and 100 microAmps. Data from electrostatic analyzers and the DC electric field experiment show that the satellite charged to near the beam energy in sunlight, if the beam current had distribution functions with peaks or plateaus at energies greater than the satellite potential. These measurements indicate heating of the ambient plasma, at several Debye lengths from the satellite (several 10s of meters), with the heated plasma then accelerated into the satellite. It is likely that the ambient plasma is, in fact, the photoelectron sheath generated by the satellite.

19727 (AD-P—005703/4/XAB) Secondary-electron generation, emission, and transport: effects on spacecraft charging and NASCAP models. Katz, I.; Mandell, M.; Roche, J.C.; Purvis, C. (S-Cubed, San Diego, CA (USA)). 1987. 12p. NTIS, PC A03/MF A01.

This article is from The Aerospace Environment at High Altitudes and Its Implications for Spacecraft Charging and Communications. Conference Proceedings of the Electromagnetic Wave Propagation Panel Symposium Held in The Hague, The Netherlands on 2-6 June 1986, AD-A185 880, 14-1-14-12.

Secondary-electron phenomena play an important role in many aspects of spacecraft charging. This paper discusses three distinct cases that show: 1)A good formulation for the secondary-electron yield as a function of incident electron energy is needed in order to determine whether a given particle spectrum will cause strong negative charging for a given spacecraft material; 2) Suppression of secondary-electron emission by electric fields plays a dominant role in sunlight charging; and 3) Surface conductivity associated with the presence of a secondary electron layer plays a key role in enhancing the current collection by small, positively biased pinholes or interconnects. The treatments of these various aspects of secondary-electron phenomena in the NASCAP and NASCAP/LEO codes provide good quantitative results for secondary-electron effects. Errors are probably due to uncertainties in the input parameters to the codes and to uncertainties in experimental measurements than to inadequacies in the code formulations.

19728 (AD-P—005704/2/XAB) Spacecraft charging: Meteosat experience. Wrenn, G.L.; Johnstone, A.D. (Univ., London (UK). Mullard Space Science Lab.). 1987. 14p. NTIS, PC A03/MF A01.

This article is from The Aerospace Environment at High Altitudes and Its Implications for Spacecraft Charging and Communications. Conference Proceedings of the Electromagnetic Wave Propagation Panel Symposium Held in The Hague, The Netherlands on 2-6 June 1986, AD-A185 880, 15-1-15-14.

Charging monitors on Meteosat 2 have given a large amount of very specific information about the interaction of the Meteosat 2 spacecraft with the plasma environment at geosynchronous orbit. Principal results so far include: 1) Differential charging occurs when part or all of the spacecraft is permanently in shadow and when there is a net flux of electrons to the spacecraft, 2) In an eclipse the current balance can charge from a triple root to a single root solution with a small charge in spectrum as had been predicted, 3) The level of differential voltages between adjacent parts of the spacecraft can be clamped at the relatively low voltage of the second cross-over point in the secondary emission yield curve (approx. volts), 4) Despite being inside a 1-metre-long, conducting baffle the radiometer mirror caused significant charging of the spacecraft, 5) Although most of the anomalies of Meteosat 2 are probably not associated with arcing they do have a natural cause, 6) Where it is not possible for the outer surface of a spacecraft to be conducting, the harmful effects of differential charging can be reduced by use of materials with high secondary-emission coefficients, 7)An electron albedo index, based on empirical values of

secondary emission coefficients and backscatter ratios has been reasonably in determining the liability of the spacecraft to charging.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 18732, 18947, 19011, 19867, 20006, 20091, 20318

19729 **(CPAT-RA—1985) [Center of Atomic Physics, Toulouse Univ.]. 1985. Progress report.** Blanc, D. (Toulouse-3 Univ., 31 (France). Centre de Physique Atomique). 1986. 180p. (In French). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87753206/JAW.

In this report, a separate item is formed for each research group and lists articles, thesis and congress communications with brief abstract. The research subjects are oriented in three principal directions: discharges in gases, atomic collisions and radiological physics.

19730 **(LBL—21475) Determination of the excited state density for an optically thick resonance line.** Richardson, R.W.; Berman, S.M. (Lawrence Berkeley Lab., CA (USA)). Apr 1986. Contract AC03-76SF00098. 17p. (CONF-8604388—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004563/JAW.

From 4. international symposium on the science and technology of light sources; Karlsruhe, F.R. Germany (7 Apr 1986).

The transverse profile of the monochromatic radiance of an optically thick resonance line from a cylindrical discharge is inverted exactly to give the radial distribution of radiating atoms. In contrast to the Abel transform, this result is valid for all optical depths. 6 refs., 1 fig. 1 tab.

19731 **(BNL—40666) A high intensity positron beam at the Brookhaven reactor.** Weber, M.; Lynn, K.G.; Roellig, L.O.; Mills, A.P. Jr.; Moodenbaugh, A.R. (City Coll., New York (USA); Brookhaven National Lab., Upton, NY (USA); Bell Labs., Murray Hill, NJ (USA)). 1987. Contract AC02-76CH00016. 15p. (CONF-870731—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005605/JAW.

From 4. international workshop on positrons in gases; London, UK (16 Jul 1987).

We describe a high intensity, low energy positron beam utilizing high specific activity /sup 64/Cu sources (870 Ci/g) produced in a reactor with high thermal neutron flux. Fast-to-slow moderation can be performed in a self moderation mode or with a transmission moderator. Slow positron rates up to 1.6 x 10/sup 8/ e/sup +//s with a half life of 12.8 h are calculated. Up to 1.0 x 10/sup 8/ e/sup +//s have been observed. New developments including a Ne moderator and an on-line isotope separation process are discussed. 21 refs., 9 figs.

19732 **(DOE/ER/13519—2) Experimental study of interactions of highly charged ions with atoms at keV energies: Progress report, February 16, 1987-January 15, 1988.** Kostroun, V.O. (Cornell Univ., Ithaca, NY (USA)). 20 Jan 1988. Contract FG02-86ER13519. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005456/JAW.

This report describes the progress made during the past year towards the understanding of the behavior of electron beam ion sources and using the sources constructed in this laboratory to investigate interactions of highly charged ions with atoms at keV energies. The operational status of the two sources in use, CEBIS I and CEBIS II is described. At present, the sources are producing beams of bare, hydrogen and helium like ions of C, N, and O, and argon ions up to Ar^{13+} with peak current pulses in the electric nanoampere range. Some of the problems encountered in the development of the sources and their resolution are discussed, and a brief description of experimental apparatus and ion beam transport line is presented. Experiments in progress are described.

19733 **Directly heated LaB_6 cathodes for ion source operation.** Leung, K.N. (Lawrence Berkeley Lab., CA, USA). *Vacuum;* **36**: No. 11-12, vp(Nov-Dec 1986). (CONF-860427—).

From 4. low energy ion beams conference and exhibition; Brighton, UK (7 Apr 1986).

Some physical properties of lanthanum hexaboride 'filaments', when operated as cathodes in a gas discharge are presented. These directly heated hairpin shaped filaments have been tested in different types of ion sources and are shown to be capable of long pulse or cw discharge operations. The characteristics of a shaped lanthanum hexaboride filament for the purpose of further extension of lifetime is described. The design and operation of a magnetic-field-free, directly-heated, coaxial LaB_6 cathode is also discussed.

19734 **Operational characteristic of a compact microwave ion source.** Walther, S.R.; Leung, K.N. (Lawrence Berkeley Lab., CA, USA). *Vacuum;* **36**: No. 11-12, 869-871(Nov-Dec 1986). (CONF-860427—).

From 4. low energy ion beams conference and exhibition; Brighton, UK (7 Apr 1986).

A small microwave ion source has been fabricated from a quartz tube with one end enclosed by a two-grid accelerator. The source is also enclosed by a cavity operated at a frequency of 2.45 GHz. Microwave power as high as 500 W can be coupled to the source plasma. The source has been operated with different geometries and for various gases in a cw mode. For hydrogen, ion current density of 200 mA cm^{-2} with atomic ion species concentration as high as 80% has been extracted from the source. It has also been demonstrated that low energy oxygen ion beams (5-10 eV) can also be extracted from the source.

19735 **(CIEMAT—598) Gamma-ray spectrometer system for low energy photons by coupling two detectors.** Martinez Lobo, A.; Palomares, J.; Romero, L.; Travesi, A. (Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid (Spain)). 1986. 18p. (In Spanish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701253/JAW.

The study performed to obtain a composited (summa) spectrum from a Low Energy Gamma Spectrometry System by coupling two planar Germanium detectors is described. This disposition allows to obtain a high counting efficiency for the total system. It shows the improvement achieved by the synthetic spectrum which is obtained by adding the two original spectra through the "LULEPS" code. This code corrects the differences (channel/energy) between both two spectra before performing the addition. (author). 6 refs., 3 figs.

19736 **(CONF-880110—18) The components of the photoionization cross section in the VUV and soft x-ray region.** Krause, M.O. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 6p. NTIS, PC A02. Order Number DE88005438/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

The photoionization cross section is partitioned into its components by analyzing the emitted photoelectrons according to energy and intensity. the principle of the method is outlined and experimental results on neon, krypton, manganese and beryllium are discussed. 9 refs., 7 figs.

19737 **(DOE/ER/13440—2) Hyperspherical coordinate theory of two-electron processes: Technical progress report, 1 August 1985-31 July 1988.** Macek, J.; Starace, A.F. (Nebraska Univ., Lincoln (USA). Dept. of Physics and Astronomy). 1988. Contract FG02-85ER13440. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005797/JAW.

The main focus of the project is electron correlations in atoms using methods based on hyperspherical coordinates. The aim of the project has been primarily to lay the ground work for state-of-the-art calculations employing hyperspherical coordinates. In addition, applications have been made to specific atomic collision processes in those cases where a hyperspherical coordinate point of view can make a significant contribution to our understanding of the physical mechanism involved. Projects directed toward state-of-the-art calculations are discussed and specific applications are described. 23 refs., 2 figs.

19738 **(EGG-M—36386) An experimental method for species concentration measurements in a welding arc using laser-induced fluorescence.** Snyder, S.C.; Shaw, C.B. Jr.; Shull, C.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 6p. (CONF-870438—39). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005638/JAW.

From Spring meeting of the Materials Research Society; Anaheim, CA, USA (21 Apr 1987).

An experimental method using laser-induced fluorescence (LIF) to determine the distribution of neutral manganese in a gas tungsten welding arc is described. The theoretical consideration and experimental difficulties encountered when extending LIF techniques from flames to thermal plasmas are discussed, and preliminary results are presented. 11 refs., 4 figs.

19739 **(IA—1427, pp 3-4) Onsager-Thomas-Fermi diatomic confined-molecules for the one component plasma.** Rosenfeld, Y.; Stein, Y.; Shalitin, D. (Israel Atomic Energy Commission, Tel Aviv; Hebrew Univ., Jerusalem, Israel). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19740 **(IA—1427) Research laboratories annual report 1986.** (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. vp. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

Individual papers have been indexed separately. (WRF)

19741 **(ORNL/M—455) Studies of compound states of negative ions using laser beams.** Compton, R.N. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Chemistry). Dec 1987. Contract AC05-84OR21400. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004708/JAW.

A brief discussion is given for the research effort in photodetachment spectroscopy and electron scattering in a laser field. (WRF)

19742 **(UCRL—97493) Numerical simulations of multiphoton processes in many electron atoms.** Kulander, K.C.; Cerjan, C. (Lawrence Livermore National Lab., CA (USA)). 1 Sep 1987. Contract W-7405-ENG-48. 10p. (CONF-870784—4). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88003293/JAW.

From NATO workshop on atomic and molecular processes with short intense laser pulse; Sherbrooke, Canada (19 Jul 1987).

In this report, we will present some details of two numerical methods which we have been pursuing for treating the multi-electron case. Both involve a numerical representation of the time dependent Hartree Fock electronic orbitals and a direct time integration of the coupled equations. Using these methods we will be able to determine the dynamics of the energy absorption process (preionization dynamics and the mechanism of ionization, i.e. whether it is direct multi-electron emission or sequential). 6 refs.

19743 **The impact of quantum Monte Carlo on chemistry.** Ceperley, D.M. (Lawrence Livermore National Lab., Livermore, CA). pp 4 of The impact of supercomputers on chemistry (Book of abstracts). London, UK; ISOC 87 Secretarist, Room 209 (1987). (CONF-8704191—).

From 1. international conference of the impact of supercomputers on chemistry; London, UK (13 Apr 1987).

Quantum Monte Carlo is an extremely powerful method for performing exact calculations of many-body systems. The first method, Green's Function Monte Carlo, can determine properties of single quantum states including excited states. It has the important property that as the guiding trial function becomes more accurate, the results become more precise and the method more efficient. The method is competitive with configuration interaction for calculating ground state properties of low Z elements but has the advantage of objective error bars. Effective core potentials will extend its scope to other elements. Also Monte Carlo can calculate properties of much larger systems, for example we have determined the equation of state of a system of several hundred hydrogen atoms at high pressures allowing both the protons and electrons to be quantum particles. A second method, Path Integral Monte Carlo, is used to calculate thermal averages but there have been no serious attempts yet to use this method for many-electron systems. It would be very exciting to combine these two methods in order to perform simulations where the electrons are nearly degenerate while the ions are nearly classical. Thus one can side-step the very difficult problem of determination of intermolecular potentials of molecular systems. The methods are readily adaptible to almost any computer architecture. The key parameter is the total number of low precision floating point operations the processor(s) can supply.

19744 **Laser bandwidth effects in resonance ionization spectroscopy of Nd.** Capelle, G.A.; Young, J.P.; Donohue, D.L.; Smith, D.H. (EG and G, Inc., Santa Barbara, CA, USA. Energy Measurements Group; Oak Ridge National Lab., TN, USA). pp 335-336 of Resonance ionization spectroscopy 1986. Proceedings of the third international symposium on resonance ionization spectroscopy and its applications held at the University College of Swansea, Wales, on 7-12 September 1986. Hurst, G.S.; Morgan, C.G. (eds.). Bristol, England; Institute of Physics (1986). (CONF-8609132—).

From Resonance ionization spectroscopy and its application; Swansea, UK (7 Sep 1986).

Price Pound 35.00.

19745 **Photoelectron spectroscopy applied to a study of laser induced photoionization of lanthanides and actinides.** Young, J.P.; Donohue, D.L.; Smith, D.H. (Oak Ridge National Lab., TN, USA). pp 355 of Resonance ionization spectroscopy 1986. Proceedings of the third international symposium on resonance ionization spectroscopy and its applications held at the University College of Swansea, Wales, on 7-12 September 1986. Hurst, G.S.; Morgan, C.G. (eds.). Bristol, England; Institute of Physics (1986). (CONF-8609132—).

From Resonance ionization spectroscopy and its application; Swansea, UK (7 Sep 1986).

Price Pound 35.00.

19746 **(IAE—4178/12) Probability of production of different dμ and tμ mesic atomic states in the liquid DT mixture.** Gurevich, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 21p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703182/JAW.

Behaviour of deuterium and tritium μ-mesic atoms in liquid DT mixture is considered. Processes of de-excitation, slowing-down, quasiresonance recharging and 2S->2P-transitions, are considered. Kinetic equations for a number of mesic atoms in different states are derived and solved. Parts of t/sub μ/ mesic atoms, which pass into metastable state 2S and slow down in it to the energies when 2S->2P transition becomes impossible, are found. Comparison with the case of pure deuterium is made. Effect of metastable 2S-state on the number of dt reactions, catalyzed by one muon, is considered. 6 references, 2 figures, 2 tables.

19747 **(IAE—4180/12) Scheme for calculating of decay rates of quasi-stationary states of molecular complexes.** Menshikov, L.I.; Fajfman, M.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703183/JAW.

On the basis of investigating two models of quasi-stationary states a correct scheme for calculating decay widths of quasi-stationary states of a wide category of systems has been developed according to the perturbation theory. A method for calculating the decay widths of quasi-stationary states of mesomolecular complexes originating in resonance formation of mesic molecules dtμ and ddμ is presented. Wave functions of the initial and final states of the mesomolecular complex and the transition operator between these states have been chosen. 18 references, 3 figures.

19748 **(DOE/ER/13492—2) Energy partitioning in elementary gas phase reactions: Progress report, November 1, 1986-October 30, 1987.** (Columbia Univ., New York (USA). Dept. of Chemistry). 30 Oct 1987. Contract FG02-86ER13492. 2p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005455/JAW.

The author reports that hydrogen-deuterium exchange reactions have been a major effort in the past year. Fast hydrogen atoms generated by photodissociation of H_2S or HCl collide with deuterium containing molecules such as D_2, HD, C_2D_2, CH_3CCD, C_2D_4, CD_4 and CH_3D.

19749 **(DOE/ER/71003—T2) Atomic and molecular collision processes: Progress report for the period January 1, 1985-November 30, 1986.** Norcross, D.W. (Joint Inst. for Lab. Astrophysics, Boulder, CO (USA)). 31 Jul 1986. Contract AT01-77ER71003. 12p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005819/JAW.

The past year's progress in a long-term program of code development and high precision calculations for electron and positron collisions with atoms, atomic ions, and molecules is summarized. In electron-ion collisions, the primary concern is with the fundamental physics of the process that controls excitation in high temperature plasmas. In the molecular work, we pursue accurate calculations of ro-vibrational excitation of polyatomic molecules, by both electrons and positrons, and the structure of molecular negative ions. 16 refs.

19750 **(IA—1432) PLASMOR: A laser-plasma simulation code. Pt. 2.** Salzman, D.; Krumbein, A.D.; Szichman, H. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Jun 1987. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701289/JAW.

This report supplements a previous one which describes the PLASMOR hydrodynamics code. The present report documents the recent changes and additions made in the code. In particular described are two new subroutines for radiative preheat, a system of preprocessors which prepare the code before run, a list of post-processors which simulate experimental setups, and the basic data sets required to run PLASMOR. In the Appendix a new computer-based manual which lists the main features of PLASMOR is reproduced.

19751 **(LBL—24165-Rev.) Multiple electron capture in close ion-atom collisions.** Schlachter, A.S. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 5p. (CONF-880136—1-Rev.). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005447/JAW.

From Symposium on atomic and surface physics; La Plagne, France (17 Jan 1988).

Multiple electron capture is reported for Ca^{17+} in Ar. Close collisions are defined by the observation of a coincident Ca K or Ar K x-ray. A large number of electrons is transferred to the projectile in a single close collision when the Ca ion projectile is of the order of the Ar L-shell electron velocity. The cross section for electron capture is reported.

19752 **(UCRL—21009-Pt.1) Reactions of N_2(A^{3}SIGMA/sub u/$^+$) and candidates for short wavelength lasers, March 1, 1984-February 28, 1985.** Setser, D.W. (Lawrence Livermore National Lab., CA (USA)). 7 Dec 1987. Contract W-7405-ENG-48. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005622/JAW.

There are several potential schemes for efficiently generating high concentrations of the first electronically excited state of nitrogen, N_2(A$^3\Sigma$/sub u/$^+$, 6.2 eV) by either chemical or electrical pumping. The goal of this proposal is to study ways of utilizing the energy of the N_2(A) molecules for developing efficient, short wavelength gas lasers. Such lasers are of potential interest for laser fusion. The authors report both excitation-transfer and dissociative excitation-transfer reactions of N_2(A) that yield electronically-excited diatomic molecules as products. 25 refs.

19753 **(UCRL—96759-Rev.1) Nuclear excitation via the motion of electrons in a strong laser field.** Berger, J.F.; Gogny, D.; Weiss, M.S. (Lawrence Livermore National Lab., CA (USA)). Dec 1987. Contract W-7405-ENG-48. 16p. (CONF-880110—16-Rev.1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005223/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

A method of switching from a nuclear isomeric state to a lasing state is examined. A semi-classical model of laser-electron-nuclear coupling is developed. In it the electrons are treated as free in the external field of the laser, but with initial conditions corresponding to their atomic orbits. Application is made to testing this model in ^{235}U and to the design criteria of a gamma-ray laser. 14 refs., 2 tabs.

19754 **Charge state populations in an XUV stressed lithium vapor.** Strobel, G.L. (Univ. of Georgia, Athens, GA 30602). pp 6 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Charge state populations have been calculated evolving from an initially neutral Lithium vapor. The vapor is stressed by the passage of an XUV pulse of approximately one microsecond through the vapor. Photo-ionization and electron induced ionization processes result in a buildup of Li/sup +/ and Li/sup ++/ ions in the vapor. Recombination limits the charge state populations in dense vapors. When recombination is small, up to a 10% fraction of the atoms will be singly charged, and up to about 2.4 10/sup -5/ of the ions will be doubly charged. The temperature of the vapor can be related to the energy absorbed from the incident XUV pulse. This results in a time dependent vapor temperature approaching 0.6 ev, depending on the source of XUV used. Various pulsed XUV sources from Sandia National Laboratory have been considered to initiate the ionization and heating of optically thin neutral vapors of thermal Lithium atoms. The strongest of these sources produced Lithium ionization fractions of 4, 7, and 10% at times of 200, 300, and 400 nanoseconds after the start of the XUV pulse. These ionization fractions are reduced by recombination significantly only if the vapor density is considerably greater than 3 x 10/sup 18/ atoms/cm/sup 3/.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 20003

19755 **(AD-A—186407/3/XAB) Laser thermal propulsion. Final report, 1 January 1983-31 August 1986.** Keefer, D. (Tennessee Univ., Tullahoma (USA). Space Inst.). 5 Jun 1987. 9p. NTIS, PC A02/MF A01.

The objective of this research investigation was to determine, experimentally and analytically, the physical mechanisms that control the behavior of continuous, laser sustained plasmas. The principal questions involve the effects of a forced-convection environment and optical geometry on the stability, fractional power absorption, plasma structure, and fluid mixing. A continuous, 1.5-kW, axial-flow, carbon dioxide laser was used to create the LSP in a cylindrical quartz flow channel. The convection flowfield surrounding the plasma was controlled by the volume flow through the test chamber, and the optical geometry was determined by the unstable oscillator output mode of the laser and the focal length of the lens. Digital images of the plasma in a selected narrow wavelength interval were obtained using a CID digital camera and a VICOM digital image processing computer that were calibrated for absolute radiance. These images were then Abel inverted to give a spatial plasma emission coefficient which determined the spatial distribution of the plasma temperature. These measured temperature fields were then used to calculate the laser power absorption in the plasma and the power lost from the plasma through optically thin emission. More than one hundred sets of data were obtained for argon plasmas at nominal pressures from 1.5 to 3 atmospheres and incident flow velocities from 0.4 to 4.0 m/s.

19756 **(DOE/ER/72012—T6) Numerical analysis, computing and fundamental studies in fluid mechanics: Summary report No. 13, April 1, 1987-March 31, 1988.** (California Inst. of Tech., Pasadena (USA)). 1988. Contract AS03-76ER72012. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005343/JAW.

Brief descriptions are given for the following research: (1) studies on two-dimensional inviscid flow, the steady shapes, linear stability and energetics of regions of constant vorticity; the principal teechnique was the method of Schwarz functions; (2) studies were initiated on the problem of vortex patches bounded by vortex sheets; and (3) studies on the structure and stability of vortical flows in viscous flow. (WF)

19757 **(UCID—20297-87-1) Granular solids flow project: Quarterly report, January-March 1987.** Walton, O. (ed.). (Lawrence Livermore National Lab., CA (USA)). Apr 1987. Contract W-7405-ENG-48. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005505/JAW.

Research under this project is aimed at obtaining a fundamental understanding of the flow behavior of granular solids. The microstructural details of deformations of idealized materials are being studied through the use of discrete-particle computer models. Space and time averages of individual particle forces and trajectories provide macroscopic bulk-material values and comparisons with experiments provide validity and calibration of the materials models. During the current reporting period we extended the range of previous parameter studies examining the effect of friction coefficient on the stresses in steady shearing flow of mono-sized assemblies of spherical particles at various solids packing fractions. Also, in preparation for a series of calculations that will compare our computer model calculations directly with laboratory chute flow measurements conducted at UCLA, we started calibrating the input parameters in our two- and three-dimensional models to physical properties measured for the cellulose-acetate beads used in the flow tests.

19758 **(UCID—20297-87-2) Granular solids flow project: Quarterly report, April-June 1987.** Walton, O. (ed.). (Lawrence Livermore National Lab., CA (USA)). Jul 1987. Contract W-7405-ENG-48. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005504/JAW.

We have continued both our development of discrete-particle computational models to simulate the flow of granular solids and the application of these models to studies of fundamental solids flow behavior. We re-evaluated our previous calculational study of shearing mixtures of two sizes of spheres. New results using higher stiffness values agree with proposed theories for mixtures of nearly equal size spheres but they still differ from theoretical predictions for mixtures with large size differences. We also added smooth but frictional planar boundaries to the 3DSHEAR model and began a calculational study of gravity driven flows on inclined planes. We also completed our first set of calculations simulating the two-dimensional chute fow measurements at UCLA. Addition of planar boundaries allowed these simulation calculations to include the effects of both base particles and frictional sidewalls; however, preliminary results indicate that we may need to add air drag effects in order to match the measured flow rates. In the numerical modeling effort, we added frictional coupling and planar boundaries to a rigid-shere model that is much more efficient than our soft-sphere 3DSHEAR model. Either model will be able to simulate inclined chute flows. This dual modeling capability will provide independent corroboration of calculations. Two-dimensional simulation calculations were performed of dilatancy effects in explosive fragmentation of oil shale. 8 refs., 3 figs.

19759 **(UCID—21328) Simulation of the Richtmyer-Meshkov instability and turbulent mixing in shock-tube experiments.** Mikaelian, K.O. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88005564/JAW.

This is a report on our code calculations in support of shock-tube experiments that are now in progress at CalTech. The primary purpose of the experiments is to study the evolution of perturbations and the subsequent mixing when a shock passes through the interface between two gases. The Richtmyer-Meshkov instability causes initial, i.e. pre-shock perturbations at an interface between two fluids to grow after the passage of the shock, much the same way as the Rayleigh-Taylor instability acts in a constant gravitational field. 13 refs., 46 figs.

19760 **(AD-A—185890/1/XAB) Magnetohydrodynamic liquid-metal flows and power losses in a rectangular channel with a moving conducting wall.** Brown, S.H.; Reilly, P.J.; Sondergaard, N.A. (David W. Taylor Research and Development Center, Bethesda, MD (USA)). 15 Jul 1987. 18p. (DTNSRDC—87-040). NTIS, PC A03/MF A01.

Pub. in Jnl. of Applied Physics, Vol. 62, No. 2, 386-396(15 Jul 1987).

Fully developed, viscous liquid-metal flows and power losses in a rectangular channel in a uniform, external magnetic field were studied for moderate Hartmann numbers and different channel-aspect ratios. The channel was assumed to have insulating side walls parallel to the field, a perfectly conducting moving top wall, and a stationary bottom wall perpendicular to the field. Exact series solutions and numerical calculations are presented for velocity profiles, induced magnetic field distributions, current densities, voltage profiles, and viscous and joulean power losses. The joulean and viscous dissipation are computed from squared quantities involving infinite series with double summations for infinite M. The diverging series derived for the viscous power losses is made convergent by slightly modifying the velocity profile of the conducting fluid at the moving interface. The effect of the applied field is to produce an eddy current that accelerates the bulk fluid to velocities greater than those without the field, but because of the presence of the side walls, the velocities are less than in one-dimensional Couette flow. Except at small aspect ratios and Hartmann number, almost the entire power loss resulted from the component of the induced current parallel to the applied field.

19761 **(AD-A—186211/9/XAB) Unified study of plasma-surface interactions for space power and propulsion. Technical report (Final), 1 November 1985-31 July 1986.** Turchi, P. (R and D Associates, Alexandria, VA (USA)). 14 Jul 1987. 37p. (RDA-TR—133700-002). NTIS, PC A03/MF A01.

The interaction of a high-speed (10-20 km/sec) plasma flow of modest temperature (0.5-5 eV) with a solid surface is a basic phenomenon in a variety of high specific-power devices, such as advanced high specific impulse thrusters. Study of the details of processes involved in the immediate vicinity of the surface is normally precluded by the very limited diagnostic access afforded in mission-oriented devices. The present research program establishes a plasma flow by means of a quasi-steady magnetoplasmadynamic arcjet and exposes simple solid surfaces to this flow while examining the plasma-surface interaction spectroscopically. Detailed measurements provide the benchmark for theoretical modeling that may then be applied to the more complex geometries of actual plasmadynamic devices. This report covers the development and characterization of the arcjet plasma source and the initial results from experimental diagnostics focused near the surface of a dielectric blunt body in a higg-speed argon flow.

19762 **(LNCC—015/87) Long-wavelength phonons and the condensate in superfluid /sup 4/He.** Olinto, A.C. (Laboratorio Nacional de Computacao Cientifica, Rio de Janeiro (Brazil)). Aug 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701515/JAW.

From Ward identities that take into account the condensate reservoir, the velocity of long-wavelength phonons is obtained as a function of the condensate fraction in the shielded potential approximation. The results are in good agreement with superfluid / sup 4/He data.

6450 High Energy Physics

19763 (DOE/ER/40085—12) High energy physics at Tufts University: Progress report, July 16, 1986 to July 15, 1987. Milburn, R.H. (Tufts Univ., Medford, MA (USA). Dept. of Physics and Astronomy). 15 Jul 1987. Contract AC02-83ER40085. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88004660/JAW.

This paper discusses topics and projects in the following areas: Soudan-II nucleon decay project, neutrino interactions at the Tevatron in the 15-foot bubbble chamber, pion and kaon production of charm and charm-strange states, multiparticle spectrometer studies at Fermilab, general kinematic description of polarization in scattering processes and spin phenomenology, polarization in inclusive hyperon production and measuring quarks helicity underlying hadronic jets. (LSP)

19764 (DOE/ER/40224—15) Polarization as a probe of high energy physics. Moravcsik, M.J. (Oregon Univ., Eugene (USA)). Jul 1985. Contract FG06-85ER40224. 22p. (CONF-8508139—4; OITS—302). NTIS, PC A03. Order Number DE88004158/JAW.

From 10. Hawaii topical conference on particle physics; Honolulu, HI, USA (26 Aug 1985).

An outline is given of the particular physical and mathematical point of view taken with respect to the exploration of polarization phenomena in particle physics, and some of the results are discussed. The quantum mechanical formalism is provided in terms of the reaction matrix and spin tensors. The applications of the optimal formalism to polarization phenomena and the results obtained from it are discussed. The four principal applications discussed are: testing of symmetry laws, determination of amplitudes from experimental data, testing of specific existing theoretical models, and searching for clues of dynamics in the situations in which knowledge of the particle dynamics is nonexistent or unreliable. 44 refs., 21 figs. (LEW)

19765 (DOE/ER/40224—43) [Theory of elementary particle studies in weak iteration and grand unification and studies in accelerator design]: Annual report. Deshpande, N.G. (Oregon Univ., Eugene (USA)). 1987. Contract FG06-85ER40224. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004261/JAW.

This paper discusses the work done in high energy physics at the University of Oregon over the post year. Some of the topics briefly discussed are: string phenomenology, horizontal symmetry, heavy quark decays, neutrino counting and new quarks and leptons, treatment of heavy particles and w-bosons as constituents of hadrons, higher twist corrections to heavy particle production, factorization in the Drell-Yan process, jets and compositeness at the SSC, minimum-bias physics in hadronic collisions, and quark-gluon plasma. (LSP)

19766 (LBL—24287) Particle ID numbers, decay tables, and other possible contributions of the Particle Data Group to Monte Carlo standards. Trippe, T.G.; Lynch, G.R. (Lawrence Berkeley Lab., CA (USA)). Nov 1987. Contract AC03-76SF00098. 12p. (CONF-8708186—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005755/JAW.

From Workshop on detector simulation for the SSC; Argonne, IL, USA (24 Aug 1987).

The Berkeley Particle Data Group is considering providing a single standard numbering scheme for use in programs for high energy physics Monte Carlo event generation, detector simulation, and analysis. The purpose is to facilitate standardizing the interfaces between these programs, to reduce the possibility for errors, and to simplify code maintenance. Several schemes have been studied and a tentative proposal is given. The possibility of the Particle Data Group providing decay tables and material properties tables is discussed.

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 19835, 19885, 20628

19767 (CERN—87-08-Vol.1) ECFA [European Committee for Future Accelerators] workshop on LEP 200, Volume 1: Proceedings. Boehm, A.; Hoogland, W. (eds.). (European Organization for Nuclear Research, Geneva (Switzerland)). 22 Jun 1987. 257p. (ECFA—87/108-Vol.1; CONF-8609223—Vol.1). CERN, European Organization for Nuclear Research, CH-1211, Geneva, Switzerland. Order Number TI88900322/JAW.

From ECFA workshop: LEP 200; Aachen, F.R. Germany (29 Sep 1986).

On the initiative of the European Committee for Future Accelerators, a workshop was organized to study experimental and theoretical aspects of the physics feasible at LEP with the beam energy increased to its design value of 100 GeV per beam. These two volumes provide the written versions of the reports presented by nine working groups to the workshop, as well as the presentations on the machine upgrade itself and the potential of hadron colliders and of HERA for LEP200 physics. Each working group studied a specific topic, evaluating in some detail the requirements both for the detectors and for the machine of W mass measurements, W decay properties, W production dynamics, electroweak radiative corrections, two-photon physics, new heavy quarks and leptons, Higgs particles, supersymmetric particles, and composite models. The Proceedings also include some of the more detailed work done in the framework of the working groups. Separate abstracts were prepared for 8 papers in Volume 1 of the proceedings.

19768 (CERN—87-08-Vol.2) ECFA [European Committee for Future Accelerators] workshop on LEP 200, Volume 2: Proceedings. Boehm, A.; Hoogland, W. (eds.). (European Organization for Nuclear Research, Geneva (Switzerland)). 22 Jun 1987. 262p. (ECFA—87/108-Vol.2; CONF-8609223—Vol.2). CERN, European Organization for Nuclear Research, CH-1211, Geneva, Switzerland. Order Number TI88900323/JAW.

From ECFA workshop: LEP 200; Aachen, F.R. Germany (29 Sep 1986).

On the initiative of the European Committee for Future Accelerators, a workshop was organized to study experimental and theoretical aspects of the physics feasible at LEP with the beam energy increased to its design value of 100 GeV per beam. These two volumes provide the written versions of the reports presented by nine working groups to the workshop, as well as the presentations on the machine upgrade itself and the potential of hadron colliders and of HERA for LEP 200 physics. Each working group studied a specific topic, evaluating in some detail the requirements both for the detectors and for the machine of W mass measurements, W decay properties, W production dynamics, electroweak radiative corrections, two-photon physics, new heavy quarks and leptons, Higgs particles, supersymmetric particles, and composite models. The Proceedings also include some of the more detailed work done in the framework of the working groups. Separate abstracts were prepared for six papers in Volume 2 of the proceedings.

19769 (DOE/ER/10587—6) Task B: Work to measure decay parameters in polarized $\Sigma p \rightarrow ne$ anti nu and CP violating parameters in K^0 decay with high precision: Progress report for period April 1, 1987-March 31, 1988. Winston, R. (Chicago Univ., IL (USA)). Dec 1987. Contract AC02-80ER10587. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004533/JAW.

19770 **(DOE/ER/10667—T3) Experimental elementary particle physics at the University of Pittsburgh: Progress report, April 1, 1987-March 31, 1988.** Cleland, W.E.; Coon, D.D.; Engels, E. Jr.; Shepard, P.F.; Thompson, J.A. (Pittsburgh Univ., PA (USA). Dept. of Physics and Astronomy). Dec 1987. Contract AC02-80ER10667. 108p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88003542/JAW.

This paper discusses research activity at the University of Pittsburgh in experimental elementary particle physics. The three main tasks included are: Study of lepton production at the SPS and study of large P/sub T/ direct photon production at the ISR; Direct photon production at the Fermi Tevatron; and Search for fractional charge particles in semiconductors. (LSP)

19771 **(DOE/ER/40194—3) University of Massachusetts: Technical progress report, 1 January 1987 to 31 December 1987.** Kofler, R.R.; Hertzbach, S.S. (Massachusetts Univ., Amherst (USA)). 10 Dec 1987. Contract AC02-85ER40194. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88003376/JAW.

In the TPC project, UMmass continues to play an important role in the maintenance and monitoring procedures of the TPC electronics and will insure its readiness for the data taking anticipated in the spring of 1988. The measurements of the Photon structure function has been completed, presented at international meetings, and been well received. The UMass contribution to the SLD has yielded a workable soltuion to the problem of shielding the detector against the intense flux of synchrotoron radiation which is generated as the electrons are transported through the final focus quadrupoles and which accomppanies the electrons at the interaction point.

19772 **(IFVE-OEF—86-119) Search for anomalously interacting stable particles in the mass range from 1.0 to 1.8 GeV/c².** Abramov, V.V.; Arbuzov, V.A.; Baldin, B.Yu. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703221/JAW.

Submitted to the journal Sov. J. Nucl. Phys.

A search for stable ($\tau > 10^{-8}$ s) anomalously interacting particles with the charge Z=+-1 has been performed in the mass range from 1.0 to 1.8 GeV/c². Secondary positive and negative particles with mean transverse momentum of 3 GeV/c produced in the collision of 70 GeV protons with the lead target have been investigated. Upper limits for invariant differential production cross-sections of anomalously interacting particles (1.8×10^{-33}-9.5×10^{-32} cm²xGeV^{-2}) per lead nucleus have been obtained at the 90 % considence level. 12 references, 7 figures.

19773 (INIS-mf—10911, pp 94) **University of Sydney underground physics program.** Peak, L.S.; Bakich, A.M. (Sydney Univ., Australia). 1986. NTIS (US Sales Only), PC A06/MF A01. Order Number DE87702489/JAW. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

19774 **(LAL—86-08) Physics at the collider.** Repellin, J.P. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Jun 1986. 40p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753210/JAW.

Between 1981 and 1984, many physics results have been obtained at the CERN pantip collider facility. In these lectures we will concentrate on the results which concern high transverse energy phenomena: observation and study of high transverse energy jets, observation and study of the intermediate vector bosons W/sup +-/, Z/sup 0/. 44 refs.

19775 **(LAL—86-22) Some Monte-Carlo simulation results on beauty at LEP.** Roudeau, P. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Jul 1986. 12p. (CONF-8605162—5). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753214/JAW.

From International symposium on production and decay of heavy flavours; Heidelberg, F.R. Germany (19 May 1986).

The Z/sup 0/ is a b factory. Spectroscopy of B mesons and measurements of B/sub s//sup 0/ - antiB/sub s//sup 0/ oscillations are thus two physics goals for LEP. Kaon identification up to 15 GeV is required for these studies. 6 refs.

19776 **(IFVE-OEF—86-154) Eta/sup '/->ωγ decay.** Aldi, D.; Binon, F.; Brikman, K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703222/JAW.

Submitted to the journal Sov. J. Nucl. Phys.

A neutral decay of the eta'(958)-meson eta' -> ωγ -> $\pi^0\gamma\gamma$ -> 4 γ is detected. The experiment has been performed at the IHEP 70 GeV accelerator with the multiphoton hodoscope spectrometer GAMS-2000. Measured branching ratio of eta' -> ωγ decay (BR=0.0330 +- 0.0036) is found to be in agreement with theoretical predictions. 16 references, 5 figures.

19777 **(LAL—86-16) Photon-photon collisions.** Haissinski, J. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Jun 1986. 27p. (CONF-8604238—5). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753212/JAW.

From 7. international workshop on photon-photon collisions; Paris, France (1 Apr 1986).

The discussions presented in this paper deal with the following points: distinctive features of gamma-gamma collisions; related processes; photon-photon elastic scattering in the continuum and γγ ->gg; total cross section; γγ -> V/sub 1/V/sub 2/ (V=vector meson); radiative width measurements and light meson spectroscopy; exclusive channels at large /t/; jets and inclusive particle distribution in γγ collisions; and, the photon structure function F γ/sub 2/.

19778 **(LAL—86-21) Search glueballs in radiative and hadronic decays of J/PSI.** Jean-Marie, B. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Jul 1986. 5p. (CONF-8605162—4). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753213/JAW.

From International symposium on production and decay of heavy flavours; Heidelberg, F.R. Germany (19 May 1986).

The DM2 collaboration has accumulated a data sample of 8.6 x 10/sup 6/ produced J/PSI. The search for glueball states necessitates to investigate the associated production and decays of ordinary hadrons. The ππ and KK pair production associated to γ, ω and phi is discussed.

19779 **(LAPP-T—86-01) Low-energy photon physics in the frame on the LEP-L3 experiment.** Boutigny, D. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). Apr 1986. 141p. (In French). NTIS (US Sales Only), PC A07/MF A01. Order Number DE87753205/JAW.

The apparatus of the experiment L3 which will be installed at the LEP is mainly optimized for detecting leptons and photons with more particularly an electromagnetic BGO calorimeter, muon chambers and a high-precision central chamber. Then, one presents a method allowing to point out the reaction e/sup +/e/sup -/ -> νantiνγ. The cross section is calculated for different hypothesis concerning the number of light neutrino generations and for several possible configurations of apparatus. The background noise has been estimated for the reactions e/sup +/e/sup -/ -> μ/sup +/μ/sup -/γ and e/sup +/e/sup -/ -> γγγ. This thesis deals also with the 1P states of the toponium; a simulation of the signal and the background noise associated to the radiative cascade is developed. Finally, one describes the tests carried out on a matrice of one hundred crystals of BGO to estimate its energy resolution, important parameter for the neutrino-counting reaction, or the search of the 1/sup 3/P states of the toponium.

19780 (LPNHEX-T—86-02) Photoproduction of charged particle with high transverse momentum. Campos Costa Ramos, S.E. de. (Ecole Polytechnique, 91 - Palaiseau (France). Lab. de Physique Nucleaire et des Hautes Energies). Sep 1986. 172p. (In French). NTIS (US Sales Only), PC A08/MF A01. Order Number DE87753215/JAW.

Inclusive cross sections of high transverse moment charged pions induced by a high energy photon beam have been measured. These results do not account, neither in slope nor in normalisation, for the VDM component of the photon, evaluated with pion induced data taken in the same experimental conditions after VDM subtraction, excellent agreement is found with QCD calculations up to second order in $\alpha/sub\ s/$, in an extended cinematic region, different choices of the gluon fragmentation function do not alter this conclusion. Our measures of the inclusive final state charge asymmetries also confirm QCD expectations. 42 refs.

19781 (MPI-PAE/Exp.El.—181) Search for hadronic events with low thrust and an isolated lepton with the CELLO detector. Kroha, H. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (Germany, F.R.). Werner-Heisenberg-Inst. fuer Physik). Aug 1987. 7p. (CONF-8705198—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751945/JAW.

From 2. topical seminar on heavy flavour physics; San Miniato, Italy (25 May 1987).

Using the CELLO detector at the PETRA e/sup +/e/sup -/-storage ring, a search for hadronic events with low thrust and an isolated lepton has been carried out. The rate of such events and the thrust distribution of inclusive lepton events show no evidence for a threshold of new sources of inclusive lepton events at the highest PETRA energies. The CELLO data thus do not support the observations of the MARK-J and JADE collaborations of an excess of muon events of this type at $\sqrt{s} > 46.3$ GeV.

19782 (PITHA—87/05) Two-muon events with low invariant mass at the CERN panti p storage ring. Geiser, A. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Experimentalphysik 3B und 3. Physikalisches Inst.). Jun 1987. 85p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751966/JAW.

In the UA1 experiment 335 two-muon events were observed which fulfil the following kinematical cuts: p/sub T/(μ) > 3 GeV/c for both muons and m($\mu\mu$) < 6 GeV/c/sup 2/. The events were classified according to charge and isolation. From the partial data set of the events with isolated unequally charged muon pairs the following cross sections for the Drell-Yan production of muon pairs with high transverse momenta result: σ/sub DY/ = 1.24+-0.21/sub stat/+-0.35/sub sys/ nb and d/sup 2/σ/dmdy = 0.24+-0.06/sub stat/+-0.06/sub sys/ nb/GeV/c/sup 2/ for m($\mu\mu$) = 0.4+-0.2 GeV/c/sup 2/, y=0. The production rate of heavy quarks determined from the data set with not isolated unequally charged muon pairs is consistent with the cross section for the banti b production determined from the complementary data set with large-invariant-mass muon pairs (m > 6 GeV/c/sup 2/) in lowest order QCD: σ(qanti q, gg -> banti b, p/sub T/(b) > 5 GeV/c, eta(b) < 2) = 1.1+-0.1/sub stat/+-0.4/sub syst/ μb. The found number of equally charged muon pairs is consistent with the B/sup 0/-anti B/sup 0/ mixing ratio determined also from the complementary data set. The case without mixing is less probable but not completely excluded. From the mass distribution for all unequally charged muon pairs the following cross section for the J/psi production with high transverse momenta results: σ = 31+-3/sub stat/+-10/sub syst/ nb. (orig./HSI).

19783 (DOE/ER/40048—39-N7) Low energy neutrino reactions in water Cerenkov detectors. Haxton, W.C. (Washington Univ., Seattle (USA). Dept. of Physics). 1987. Contract AC06-81ER40048. 15p. (CONF-8706260—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004227/JAW.

From Workshop on nonaccelerator physics; Rochester, NY, USA (1 Jun 1987).

The author discusses the charged-current nuclear response of water Cerenkov detectors to neutrinos from supernovae, the neutral current nuclear response of carbon-bearing liquid scintillation detectors, and the possibility of detecting ^{8}B solar neutrinos with a water Cerenkov detector enriched in ^{18}O. 12 refs., 1 fig., 2 tabs.

19784 (IFVE-ONF—86-133) Inclusive rho^0 meson production in neutrino interactions at the SKAT chamber. Ammosov, V.V.; Ivanilov, A.A.; Ivanov, P.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702745/JAW.

Inclusive rho^0-meson production in the charged current interactions has been studied in the experiment on the SKAT bubble chamber with freon filling exposed to the Serpukhov accelerator neutrino beam. An average multiplicity of the rho^0-meson 0.09+-0.02, the ratio <rho^0>/<π^->=0.10+-0.02 have been obtained. The W^2 dependence of the average multiplicity W^2 square of hadron effective mass and differential distributions over variable X/sub F/, Z, P/sub T/^{2} are presented. 19 references, 6 figures, 1 table.

19785 (LA-UR—88-97) Intermediate energy neutrino physics. White, D.H. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 31p. (CONF-8707141—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005378/JAW.

From Theoretical advanced summer institute; Santa Fe, NM, USA (6 Jul 1987).

Occasionally, our understanding of a situation in physics is apparently so clear that consequences of a particular experimental result can imply a substantial confrontation with our view of the physical world. The standard model of electroweak interactions is now so clear that a number of experimental consequences are precisely predicted. This seems like a delightful situation for experimenters, but the bad news is that the experiments on which the predictions rest are at least hard and certainly expensive. We will focus on one such an experiment in this talk; the principal goal of the experiment was to measure neutrino-electron scattering, and also to measure a number of other exclusive channels in neutrino scattering which have bearing on our view of hadronic electroweak interactions. Study of neutrino-proton scattering and neutrino oscillation is also reported. 29 figs.

19786 (LAL—86-13) Frejus experiment status of the analysis. Laplanche, F.; Arpesella, C.; Bareyre, P. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). May 1986. 8p. (CONF-8603118—8). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753211/JAW.

From 21. Recontre de Moriond: perspectives in electroweak interactions and unified theories; Les Arcs, France (9 Mar 1986).

An analysis of data taken with the Frejus Nucleon decay detector for an exposure of .55 k.ton.years (fiducial) is presented. Neutrino Monte Carlo simulations are compared to experimental data.

19787 (IFVE-OEF—86-2) Polarization parameters in the reactions πp p/sub arrow up/ -> etan and π^-p/sub arrow up/ -> eta'n at 40 GeV/c. Apokin, V.D.; Arestov, Yu.I.; Avvakumov, I.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700191/JAW.

Measurements of the polarization parameter in the π^-p -> etan and π^-p -> eta'n reactions at 40 GeV/c with squared four-momentum transfer -t ranging from 0 to 2.6 (GeV/c)^2 and 1.0 (GeV/c)^2, respectively, have been made. A propane-diol polarized target was used in the experiment. Only the gammas from the neutral meson decay were detected. The polarization parameter of the first reaction turns out to be negative in a wide t-interval (0.05 < -t < 1.6 (Gev/c)^2) and probably changes its sign at larger values of t. The averaged value of the polarization parameter of the second reaction is equal to (-17+-8)% in the region 0.05 < -t $\leqq$ 0.5 (GeV/c)^2. 18 references, 7 figures.

19788 **(IFVE-OEF—86-92) Matrix element of the eta/sup '/(958) -> eta$\pi^0\pi^0$ decay.** Aldi, D.; Binon, F.; Brikman, K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 7p. (In Russian). (SERP-E—140). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703216/JAW.

Submitted to the journal Sov. J. Nucl. Phys.

The parameters of a linear matrix element have been measured for the eta' -> eta$\pi^0\pi^0$ decay in a high statistical and systematical accuracy experiment performed at the IHEP 70 GeV accelerator. GAMS-2000 hodoscope spectrometer was used to detect six photons from the eta' decay. It is shown that the matrix element is practically constant; it depends slightly upon only one of the Dalitz variables. 20 references, 4 figures.

19789 **(IFVE-OEF—86-110) Study of a possible exotic phiπ0 state with a mass of about 1.5 GeV/c^2.** Bityukov, S.I.; Dzhelyadin, R.I.; Dorofeev, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703218/JAW.

Submitted to the journal Phys. Lett.

New data have been obtained on a resonance in the phiπ^0 system which is formed in the charge-exchange reaction π^-p -> phiπ^0n. The experiments were carried out on the 70 GeV accelerator at Serpukhov. The mass and width of the resonance are: M/sub c/=1480 +- 40 MeV and G/sub c/=130 +- 60 MeV. The cross section has been determined at a momentum of 32.5 GeV/c: $\sigma(\pi^-$p -> Cn)xBr(C -> phiπ^0)=40 +- 15 nb. The C meson has an isospin I=1 and J/sup PC/=1/sup --/. It is strongly coupled to the phiπ^0 channel and is regarded as a possible exotic meson. 12 references.

19790 **(IFVE-OEF—86-114) Structure of eta'eta system with 2.22 GeV mass observed in πp p collisions at 38 and 100 GeV/c.** Aldi, D.; Binon, F.; Brikman, K. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703220/JAW.

Submitted to the journal Sov. J. Nucl. Phys.

A structure has been observed at 2220 MeV in the mass spectrum of eta'eta systems produced by 38 GeV/c and 100 GeV/c negative pions on protons. Observation is made independentally in two experiments performed at IHEP and CERN accelerators with GAMS multiphoton spectrometers. The angular distribution of the decay products shows that this state has a spin J≧2. 11 references, 4 figures.

19791 **(IFVE-OEIPK—86-52) Boson resonance production in p-barp interactions at 32 GeV/c.** Kozlovskij, E.A.; Bumazhnov, V.A.; Zakamskij, L.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 25p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703224/JAW.

New data on inclusive production of rho°(770), f(1270) and S*(975) resonances in p-barp-interaction at 32 GeV/c are presented. The estimates of topological cross section for rho°(770) and f(1270) mesons have been obtained. The data for their differential cross section of longitudinal and transverse momenta are presented.

19792 **(IFVE-OEIPK—86-115) Inclusive production of π+- mesons in assoiciation with two leading particles in K$^+$p reactions at 32 GeV/c.** Azhinenko, I.V.; Belokopytov, Yu.A.; Amaglobeli, N.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700195/JAW.

Submitted to the journal Yad. Fiz.

Inclusive x-spectra of π/sup +-/-mesons produced in association with K/sub s/° (or K/sub 890/*+) and p (or Δ_{1232}^{++}) in K$^+$p-reactions at 32 GeV/c in the Mirabelle bubble chamber experiment are presented. 15 references, 3 figures.

19793 **(IFVE-OEIPK—86-156) Charge structure of annihilation events in p-barp interactions at 32 GeV/c.** Bogolyubskij, M.Yu.; Kiryunin, A.E.; Levitskij, M.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703225/JAW.

Submitted to the journal Yad. Fiz.

The charge properties of annihilation exclusive reactions in p-barp-interactions at 32 GeV/c are discussed. It is shown that in p-barp annihilation two or three valence quarks of the initial nucleon are conserved at 32 GeV/c. 8 references, 7 figures.

19794 **(IFVE-OEIPK—86-157) Study on the two-particle inclusive K$^+$p reactions at 70 GeV/c.** Ron'zhin, V.M.; Fenyuk, A.B.; Shlyapnikov, P.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703226/JAW.

Submitted to the journal Sov. J. Nucl. Phys.

Experimental data on inclusive pair production of strange particles K/sup n/K/sup n/, K/sup n/Λ, K/sup n/Λ-bar, $\Lambda\Lambda$-bar and associated production of Λ(Λ-bar) with slow protons obtained in the 70 GeV/c K$^+$p experiment with the BEBC bubble chamber are presented. Total inclusive cross sections and inclusive particle spectra are measured, the data obtained are compared with the Lund quark-fragmentation model. 15 references, 3 figures, 5 tables.

19795 **(IFVE-OEIPK—86-162) Study on the three-particle K$^+$p -> K$^+$K$^+\Lambda$ and K$^+$p -> ppΛ-bar reactions at 32 GeV/c.** Gerdyukov, L.N.; Shlyapnikov, P.V.; Makharadze, T.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703227/JAW.

Experimental data on K$^+$p -> K$^+$K$^+\Lambda$ and K$^+$p -> ppΛ-bar reactions at 32 GeV/c obtained in the hydrogen bubble chamber Mirabelle are presented. It is shown that the secondary particle spectra on longitudinal momenta are well described by simple quark parton model. 7 references, 7 figures.

19796 **(IFVE-OEIPK—86-167) Study on the quark-diquark fragmentation mechanism in pp interactions at 360 Gev/c.** Bailli, D.L.; Batunin, A.V.; Bushbek, B. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703228/JAW.

Submitted to the journal Pis'ma Zh. Ehksp. Teor. Fiz.

The data on inclusive meson and baryon production in pp interactions at 360 GeV/c are presented and analysed in terms of a simple parton model picturing nucleon as a bound system of three quarks or quark and diqurak. The conclusion is drown that the diquark hypothesis is essential for qualitative description of the inclusive spectra. 22 references, 3 figures.

19797 **(IFVE-OEIPK—86-174) Study of the Λ hyperon inclusive production in the target fragmentation region in pp interactions at 360 Gev/c in the frameworks of the triple Regge analysis.** Aziz, M.; Banerzhe, S.; Bartl, V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703229/JAW.

Submitted to the journal Pis'ma Zh. Ehksp. Teor. Fiz.

A study of Λ production has been made in the target fragmentation region from pp-interactions at 360 GeV/c. The triple Regge analysis of the differential cross section of Λ production led to an estimate of the kaon trajectory intercept as ≃ - 0.6. The charge multiplicities and moments from virtual K$^+$p-interactions have been studied as a function of the m.c. energy of the virtual K$^+$p-system. The results agree well with the real data of K$^+$p-interactions. 6 references, 3 figures.

19798 (IFVE-ONF—86-211) Supression of a process of two valence quark recombination of π/sup +/ meson in its fragmentation into rho/sup +/. Adamus, M.; Azhinenko, I.V.; Belokopytov, Yu.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 8p. (In Russian). (CERN-NA—22). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700638/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

Inclusive rho/sup +/, rho/sup 0/, rho/sup -/ and ω/sup 0/ production cross sections are measured in the beam fragmentation region of π/sup +/rho interactions at 250 GeV/c. The near equality of the rho/sup +/ and rho/sup 0/ production cross sections implies suppression of valence quark recombination in pion fragmentation into vector mesons. The ratio ω/sup 0//rho/sup 0/ equals 0.45 +- 0.11 at Feynman variable x $\geqq$ 0.3 and strongly decreases with increase of x. 17 refs.; 3 figs.; 1 tab.

19799 (IFVE-ONF—87-17) Study of charged hadron inclusive characteristics in neutrino interactions with photoemulsion and neon nuclei. Ammosov, V.V.; Ammar, R.; Bakich, A. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij; Kansas Univ., Lawrence, USA; Sydney Univ., Australia). (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1987. 9p. (In Russian). (FNAL—564). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701449/JAW.

Submitted to the journal Sov. J. Nucl. Phys. .

Comparative analysis results of the secondary hadrons inclusive characteristics in neutrino interactions with photoemulsion and neon nuclei at the energies of 10-200 GeV are presented. It is shown that the whole complex of data on the multiple production of the secondary particles is satisfactorily described in the frames of the parton-hadron cascade with the mean square of the transverse parton mass μ/sup 2/=0.08 GeV/sup 2/. 12 refs.; 4 figs.; 1 tab.

19800 (IFVE-OTF—86-233) Inclusive eta' as an indicator of gluonic fields in hadron collisions. Batunin, A.V.; Likhoded, A.K.; Petrov, V.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701303/JAW.

π/sup 0/, eta and eta' inclusive production in π/sup -/p-collisions is studied. The NA-27 experimental data are shown to be in a good agreement with the model of quark "string" fragmentation for the case of π/sup 0/- and eta-mesons. The eta'-meson yields are anomalously large and for their explanation one has to use an additional mechanism connected with the presence of a gluon component of initial hadrons. 12 refs.; 5 figs.

19801 (INIS-mf—11600) Precision measurement of the analyzing power in the proton-proton scattering at 12 MeV. Rauscher, A. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Naturwissenschaftliche Fakultaet 1 - Mathematik und Physik). 14 Nov 1986. 90p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751925/JAW.

For the study of the non-central parts of the nucleon-nucleon interaction a precision measurement of the analyzing power of the reaction /sup 1/H(p vectorp) at 12 MeV was performed. The measurements were performed with the Erlangen windowless jet-gas target which was installed at the EN tandem accelerator of the ETH Zuerich. It was measured at 13 scattering angles in the range from 5/sup 0/ to 45/sup 0/ in the laboratory system and thereby a statistical accuracy of about 8 . 10/sup -5/ was reached. The maximal effect is -3.3 . 10/sup -3/ at λ/sub lab/ = 10/sup 0/. For the angles up to 22.5/sup 0/ the protons were detected in coincidence with the recoil protons with plastic scintillators while for the remaining scattering angles surface-barrier counters were used. The evaluation of the data was performed in the framework of a scattering phase analysis whereby it was cared much about a correct treatment of the vacuum polarization. The electrical non-central p-wave scattering phase combinations Δ/sub LS/ and Δ/sub T/ were determined to Δ/sub LS/ = 0.274/sup 0/+-0.036/sup 0/ respectively Δ/sub T/ = -1.202/sup 0/+-0.012/sup 0/. The regardment of preliminary depolarization data measured in Erlangen yielded practically the same results. From the p scattering phases of this thesis and the results of other authors the scattering lengths and the effective ranges were calculated. A comparison of the measured data with the predictions of current potential models and energy-dependent phase analyses showed indeed low, in the framework of the error however significant differences.

19802 (JINR—R-1-86-771) Main properties of the p-barp -> p-barpπ/sup +/π/sup -/ reaction at 22.4 Gev/c. Batyunya, B.V.; Boguslavskij, I.V.; Bruntsko, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1986. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701385/JAW.

Submitted to the journal Yad. Fiz. .

It is shown that two mechanisms to be important in the p-barp -> p-barpπ/sup +/π/sup -/ reaction at 22.4 GeV/c are the single diffraction dissociation with σ/sub D/(p)=σ/sub D/(p-bar)=(0.42+-0.02) mb cross section and the double isobar production Δ/sup ++/Δ/sup ++/ with σ=(0.25+-0.03) mb cross section. The cross sections of isobar Δ/sup ++/, Δ/sup ++/ and rho/sup 0-/, f/sup 0-/ meson production have been determined. The structure in diffractive N$\pi\pi$ system connected with N* (1500) and N* (1700) isobars has been observed. The study on angular characteristics in p-barp -> Δ/sup ++/Δ/sup ++/ reaction provides information about a remarkable contribution of one-pion exchange mechanism. 20 refs.

19803 (KFK—4293) Determination of the coupling constant α/sub s/ of strong interaction. Hansmeyer, J. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). Sep 1987. 139p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751942/JAW.

Multihadronic events measured with the CELLO detector in the energy range from 14 to 46 GeV have been analyzed in terms of the jet measures thrust, jet masses and the asymmetry of the energy-energy correlation. The data have been compared with 2nd order QCD calculations. Limits on Λ/sub ms/ have been derived independent from fragmentation models as: Λ/sub ms/ < 499 MeV, α/sub s/(35 GeV) < 0.165 and Λ/sub ms/ > 65 MeV, α/sub s/(35 GeV) > 0.115. A parametrization of the energy dependence of the fragmentation effects gives Λ/sub ms/ = 310 +- 20 stat. (+90-60) syst. [MeV] corresponding to α/sub s/ at 35 GeV: α/sub s/ = 0.15 +- 0.002 stat. (+0.008-0.006) syst.

19804 (KFK—4317) Determination of the real part of the isospin-even forward-scattering amplitude of pion-nucleon scattering at 55 MeV as a test of low-energy quantum chromodynamics. Wiedner, U. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). Sep 1987. 122p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751944/JAW.

The cross sections of elastic scattering of pions (π/sup +-/) on protons at a pion energy of T/sub π/ = 55 MeV was measured in the Coulomb-nuclear-interference region (Θ/sub lab/ = 8/sup 0/ to 28/sup 0/) at the πM3-channel at SIN. The difference of the cross sections for π/sup +/p and π/sup -/p allows a determination of the isospin-even forward scattering amplitude Re D/sup +/(t). A linear extrapolation to t=0 leads to the value Re D/sup +/ at t=0. By means of dispersion relations the knowledge of Re D/sup +/(t=0) allows the determination of the pion-nucleon σ-term at an unphysical point ν=0, t=0 (or at the Cheng-Dashen point ν=0, t=2m/sub π//sup 2/). Previous determinations of this σ-term done by Koch and Hoehler results in a value (60+-8) MeV. Calculations with chiral pertubation theory of QCD by Gasser and Leutwyler results in a value of (35+-5) MeV for this σ-term. This discrepancy between these two values leads to motivation of the above described experiment. The experimental part was done with a liquid hydrogen target and a detector system containing multiwire-proportional chambers and a range telescope. The analysis of the ex-

perimental data supports heavily the value Re D/sup +/(t=0) of Koch and Hoehler and therefore the value of (60+-8) MeV for the σ-term. The disagreement between the value for the σ-term of Gasser and Leutwyler obviously persists.

19805 (LBL—23437) Progress toward identification of gluonic states. Chanowitz, M.S. (Lawrence Berkeley Lab., CA (USA)). 29 May 1987. Contract AC03-76SF00098. 23p. (CONF-8704177—8). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005740/JAW.

From 2. international conference on hadron spectroscopy; Tsukuba, Japan (16 Apr 1987).

Progress in the last two years toward identification of gluonic states is reviewed. Discovery of additional pseudoscalars tends to confirm the glueball interpretation of iota(1460). A variety of evidence indicates new physics in the J = 1 channel in the E mass region. 65 refs., 1 tab.

19806 (SLAC-PUB—4505) Recent results for Mark III. Brient, J.C. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Dec 1987. Contract AC03-76SF00515;AC02-76ER01195;AC03-81ER40050. 12p. (CONF-870821—7). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005778/JAW.

From SLAC summer institute on particle physics; Stanford, CA, USA (10 Aug 1987).

This paper presents recent results from the Mark III detector at SPEAR, in the open charm sector. The first topic discussed is the reanalysis of the direct measurement of the D hadronic branching fractions, where a detailed study has been made of the Cabibbo suppressed and multi-π^0's D decays backgrounds in the double tag sample. Next, the Dalitz plot analysis of the D decays to $K\pi\pi$ is presented, leading to the relative fractions of three-body versus pseudoscalarvector decays. 7 refs., 5 figs.

19807 (SLAC-PUB—4508) B physics. Gilman, F.J. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Dec 1987. Contract AC03-76SF00515. 10p. (CONF-8711128—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005777/JAW.

From Workshop on high sensitivity beauty physics at Fermilab; Batavia, IL, USA (11 Nov 1987).

We review B physics and the motivation for studying B decays, including CP-violating effects in the B meson system. 33 refs., 20 figs.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 19713, 19767, 19768, 19785, 19836, 19839, 19841, 19851, 19852, 19856, 19912

19808 (INP—1256/PH) Quark mass and baryon numbers of empty chiral bags. Jezabek, M.; Zalewski, K. (Institute of Nuclear Physics, Krakow (Poland)). 1984. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701352/JAW.

We show that for spherical chiral bags the baryon number of the Dirac vacuum inside the bag does not depend on quark masses. Thus, the sum of the baryon numbers of an empty chiral bag and of the skyrmion surrounding the bag is an integer, which depends on the boundary condition on the surface on the bag. This extends the result obtained by Goldstone and Jaffe for massless quarks.

19809 (INP—1265/PL) Possible sum rules technique for calculating trajectories of Regge poles in QCD. Kwiecinski, J. (Institute of Nuclear Physics, Krakow (Poland)). 1984. 19p. (TPJU—22/84). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701359/JAW.

The technique of QCD sum rules permitting to calculate trajectories of mesonic Regge poles and their couplings is formulated. It utilizes analyticity in momentum transfer t of the moments of the appropriate four current amplitude for arbitrary value of the moment index n and for large virtualities of the currents. The sum rules relate parameters of Regge poles to the large t part of those moments which is controlled by perturbative QCD and by non-perturbative corrections. Preliminary analysis of the sum rule which gives the Q - A/sub 2/ - ω - f/sub 0/ trajectory is presented.

19810 (RAL—87-070) Exactly soluble Hartree problem in an external potential. Gunn, J.C.; Gunn, J.M.F. (Rutherford Appleton Lab., Chilton (UK)). Sep 1987. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751916/JAW.

The problem of N bosons interacting with each other via repulsive delta function interactions and with an external, attractive, delta function potential is solved within the Hartree approximation, exactly. It is found that if the interparticle interactions are above a certain value, there is no bound state. Thus the bound state does not just expand to compensate for the increase in the repulsive Hartree potential. Moreover as the interaction strength is increased to that value, the ground state wave function develops a pole at the position of the attractive potential.

19811 (LAPP-TH—167) On the covariant quantization of the free bosonic string. Baulieu, L.; Becchi, C.; Stora, R. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). Jul 1986. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753203/JAW.

The covariant quantization of the free bosonic string in the Landau type background metric gauge is formulated in terms of the Slavnov identity which constrains the correlation functions of the energy momentum tensor. The resulting theory is a "conformal" theory.

19812 (LBL—24375) Physics at large transverse momenta. Hinchliffe, I. (Lawrence Berkeley Lab., CA (USA)). Dec 1987. Contract AC03-76SF00098. 20p. (CONF-870739—15). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005758/JAW.

From Workshop on experiments, detectors, and experimental areas for the supercollider; Berkeley, CA, USA (7 Jul 1987).

The methods used in estimating the signals and backgrounds involved in searches for new particles at the SSC are reviewed. A brief summary is given of the problems involved in these searches. The required detector parameters are summarized and an indication of the open problems given. 41 refs., 8 figs.

19813 Baryogenesis at the weak phase transition. Dannenberg, A.; Hall, L.J. (Lawrence Berkeley Lab., CA, USA). *Physics Letters [Section] B;* **198**: No. 3, 411-415(26 Nov 1987). Contract AC03-76SF00098.

The weak phase transition of the hot big bang can produce quarks, leptons and weak bosons which are out of thermal equilibrium. In a simple extension of the standard model it is shown that the reactions following top quark decays can generate the cosmological baryon asymmetry. The top quark mass must be close to 80 GeV and the Higgs boson must be lighter than 1 GeV. This baryogenesis mechanism can be directly tested at e/sup +/e/sup -/ and hadron colliders by searching for spectacular events containing six or more bottom quarks and a violation of baryon number at the decay vertex of a long lived neutral particle.

19814 Effective one-loop action in the strongly interacting standard electroweak theory. Cheyette, O.; Gaillard, M.K. (Lawrence Berkeley Lab., CA, USA; California Univ., Berkeley, USA. Dept. of Physics). *Physics Letters [Section] B;* **197**: No. 1/2, 205-212(22 Oct 1987). Contract AC03-76SF00098.

One-loop corrections to the effective gauged σ-model of the large Higgs mass limit of the standard electroweak model are presented. The one-loop corrected strong scattering amplitude is obtained by a resummation of the derivative expansion. A significant enhancement is found for longitudinal W and Z scattering cross sections in the TeV center of mass energy region.

19815 (LAL—87-08) Photon structure function at large Q/sup 2/. Cordier, A.; Zerwas, P.M. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Jan 1987. 10p. (CONF-8609223—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753186/JAW.

From ECFA workshop: LEP 200; Aachen, F.R. Germany (29 Sep 1986).

LEP II offers the unique opportunity to measure the photon structure function over a large Q/sup 2/ range up to — 2000 GeV/sup 2/. Two crucial predictions of QCD can be tested in this experiment: the linear rise in log Q/sup 2/ as a consequence of asymptotic freedom, and the large renormalization O(1) of the shape of the structure function due to gluon bremsstrahlung, unperturbed by higher-twist effects.

19816 **(LAL—87-11) How to compute in practice the energy carried away by soft photons to all orders in α.** Haissinski, J. (Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire). Mar 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753185/JAW.

Based on Yennie, Frautschi and Suura's results, an analytic expression is given for the differential cross section with respect to the total energy carried away by soft photons in any collision or decay process. This expression only involves Lorentz invariant dot-products between the particle 4-moments. It is valid to all orders in the fine structure constant α.

19817 **(LAPP-TH—159) Processes related to photon-photon collisions.** Aurenche, P. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). May 1986. 27p. (CONF-8607340—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753201/JAW.

From 7. international workshop on photon-photon collisions; Paris, France (1 Jul 1986).

We first consider reactions involving two photons, the cross-sections of which contain the fourth power of the electric charges of the quarks. The reactions are: a) e/sup +/e/sup -/ -> γX, with a virtual internal photon; b) γh -> γX, i.e. deep inelastic Compton scattering (DICS); c) h/sub 1/h/sub 2/ -> γγX, i.e. photon pair production in hadronic collisions. Traditionally, these processes are used to discriminate between integrally charged quark models (ICQM) on the one hand and fractionally charged quark models (FCQM), as exemplified by QCD, on the other hand. It will be seen that the most recent experimental data definitively exclude the various versions of ICQM. On the contrary, QCD is consistent with data. In the second part, we consider processes with one real photon: d) γh/sub 1/ -> h/sub 2/X i.e. hadron photoproduction; e) h/sub 1/h/sub 2/ -> γX i.e. prompt photon production. Theoretically, they are related to processes b) and c) by considering diagrams where one photon has been replaced by a gluon. They are also related experimentally since the measurement of directly produced photons requires the knowledge of indirectly produced photons from π/sup 0/ decay: e.g. γp -> γX and γp -> π/sup 0/X should be measured to extract the direct γ signal. From the theoretical point of view, reactions with real photons offer several advantages over purely hadronic processes. These advantages derive from the fact that the photon couples directly to the constituents of the hadrons and therefore takes part in the hard scattering subprocesses. One has, thus, a better insight in the dynamics of the reaction. The calculation involves less, structure functions and therefore the predictions should be more reliable. Finally the higher order corrections have been calculated and meaningful comparison to data can be made.

19818 **(JINR-E—2-86-595) Adler relation and neutrino-production of single hadrons.** Belkov, A.A.; Kopeliovich, B.Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700263/JAW.

Submitted to the journal Yad. Fiz.

The processes of single hadron neutrino production (reaction νA -> μhA', where h=π, A/sub 1/,...) are considered from the viewpoint of experimental verification of PCAC predictions. Dispersion generalization of the Adler relation for neutrino reactions in the range of physical values of 4-momentum transfer Q^2 not = 0 is obtained. This generalization is used to calculate the cross sections for neutrino production of single pions in coherent and incoherent processes on nuclei. The results of calculations are compared with experimental data on the reaction ν-barNe -> $\mu^+\pi^-$Ne. A procedure of the coherent event selection in the experiment is discussed. A process of single A/sub 1/-meson neutrino production is considered. 23 references.

19819 **(UWThPh—1987-33) Phenomenology of CP violation.** Ecker, G. (Vienna Univ., Austria. Inst. fuer Theoretische Physik). (Vienna Univ. (Austria)). 1987. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701537/JAW.

A short survey of the theoretical status of CP violation is presented. The Standart Model is confronted with the present experimental situation. Possible future tests of our notions of CP violation are discussed, concentrating on rare K decays. Other promising reactions such as B decays are briefly reviewed. Among alternative models of CP violation, multi-Higgs extensions of the Standart Model, left-right symmetric gauge theories and minimal SUSY models are discussed. Finally, the relevance of generalized CP invariance is emphasized. 64 refs., 7 figs.

19820 **(DESY—86-110) Study of high-transverse momentum quark and gluon jet fragmentation.** Ghez, P.; Ingelman, G. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). Sep 1986. 16p. (LAPP-EXP—86-06). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753199/JAW.

The fragmentation properties of high-transverse momentum jets are investigated using new data from the ISR and the SPS collider. Effects from gluon radiation are clearly demonstrated by comparison with a state-of-the-art model including QCD parton cascade evolution and string hadronization, which gives in general good agreement with the data. Differences between quark and gluon jets are discussed as well as Q/sup 2/-dependent scaling violation effects.

19821 **(DOE/ER/40224—45) The angular ordering in soft-gluon emission.** Tesima, Kiusau. (Oregon Univ., Eugene (USA). Inst. of Theoretical Science). Jun 1987. Contract FG06-85ER40224. 10p. (CONF-8705163—10; OITS—360). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004546/JAW.

From Madison SSC workshop: from colliders to supercolliders; Madison, WI, USA (11 May 1987).

The way to evaluate multi-parton cross-sections systematically is discussed. In the leading-double-log approximation in QCD, the successive emission of soft gluons is at successively smaller angles. The angular ordering, however, is violated in the next-to-leading order.

19822 **(EFI—854(5)-86) Inclusive specta of hadronic resonances in the framework of multiparton recombination model. 1. Proton fragmentation.** Badalyan, R.G.; Gulkanyan, G.R.; Korchagin, S.A. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702701/JAW.

Spectra of direct fragmentation of proton into baryonic and mesonic resonances with small transverse momenta are obtained in te framework of multiparton recombination model. Calculations satisfactorily describe the available experimental data on the x-dependence of inclusive spectra of baryonic Δ^{++}(1232), Σ^{+-}(1385) and mesonic rho^0, K^+(1430), K^+(890) resonances in a wide (over x) range of proton fragmentation in pp, K^{+-}p and π^{+-}p interactions at high energies.

19823 **(EFI—888(39)-86) Inclusive spectra of pseudoscalar eta,eta',i(1440) mesons with account of quark-gluon mixing.** Badalyan, R.G.; Nazaryan, A.E. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700156/JAW.

Within the multiparton recombination model with account of quark-gluon mixing in eta, eta', i(1440) mesons the inclusive spectra of the mesons in hadron-hadron interactions in the proton fragmentation region are obtained. A possibility to determine by inclusive spectra of these mesons a portion of the initial proton gluonic sea fragmentizing to gluonic state is pointed out. 13 references, 4 figures.

19824 (IFVE-OEF-OTF—85-44) Mass spectra of the etaeta and eta'eta systems near threshold in the πp -> etaetan and $\pi^- p$ -> eta'etan reactions and the G(1590) meson. Gershtejn, S.S.; Kulik, A.V.; Likhoded, A.K.; Prokoshkin, Yu.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1985. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703223/JAW.

The contribution of double-reggeon diagrams is considered in the near threshold region of $\pi^- p$ -> etaetan and $\pi^- p$ -> eta'etan reactions. It is shown that the account of this contribution does not change the conclusion about the glueball nature of G(1590) meson. 7 references, 2 figures.

19825 (INIS-BR—866) Glueballs in the PI⁻p->PHI-PHIn reaction. Caruso Neto, F. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1983. 148p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88700202/JAW.

The present status of glueballs, including theoretical and experimental aspects are critically reviewed. A set of favored processes where it may be possible to search for these objects is presented. Some of the existent problems related to the unambiguous prediction of their properties are stressed. A model which is able to explain the experimental data for the reaction PI⁻p->PHIPHIn, allowing us to estimate the coupling constants G/sub PHIPHI/ and G/sub PIPI/ of a glueball 2^{++} state to PHIPHI and PIPI, respectively is proposed.

19826 (IPNO-TH—87-17) Effect of rho exchange on the scattering asymmetry in NN -> N Δ transition. Auger, J.P.; Silbar, R.R.; Lazard, C.; Lombard, R.J. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Mar 1987. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751882/JAW.

Analysis of the scattering asymmetry for the NN -> NΔ reaction suggests this reaction is less peripheral than previously believed. Short-range mechanisms are introduced by adding rho exchange Born terms to the unitary NN -> NΔ amplitudes built up from iterated pion exchanges. This dramatically improves the agreement of the model with recent data on the scattering asymmetry. Further measurements of spin observables would help in understanding the short-range nature of the NN -> NΔ transition.

19827 (IPNO-TH—87-28) Effective Lagrangean for low energy hadron physics with anomalies. Lacombe, M.; Loiseau, B.; Vinh Mau, R.; Cottingham, W.N. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Apr 1987. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751884/JAW.

A chiral invariant effective Lagrangean is constructed from pions and the low mass mesons taking full account of the Wess-Zumino anomalies. The parameters of the model are determined by theoretical constraints as well as experimental observables in the meson sector. Soliton solutions of this Lagrangean are found. These are used to predict properties of baryons. If the parameters are given strictly by the values estimated in the meson sector the baryon masses come out too high. We find however that a satisfactory fit can be achieved by using a parameter set close to the ones needed in meson physics. We also find the Wess-Zumino anomalies although important for meson physics are of much less significance for the baryons.

19828 (ITEP—195(1986)) Orbital excitation of exotic mesons and the baryonium problem. Kondratyuk, L.A.; Martem'yanov, B.V.; Shchepkin, M.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701383/JAW.

The peculiarities of spectrum of orbitally excited q/sup 2/-q/sup -2/ system are discussed in the model of relativistic string with spin-orbit coupling. The meson trajectories q/sup 2/-q/sup -2/ and spin-orbit splitting of different states are considered. The relation between q/sup 2/-q/sup -2/-spectrum, baryonium and NN-bar interaction is also discussed. 25 refs.; 4 figs.

19829 (JINR—R-2-87-89) A/sub 1/ -> πrho, a/sub 1/ -> πγ and π/sup -/ -> eν-bary decays in the quark model of the superconducting type. Volkov, M.K.; Ivanov, A.I.; Nad', M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701386/JAW.

Submitted to the journal Phys. Lett. B.

It is shown that in quark models the ratio of axial and vector form factors which is not equal to one for the process π/sup -/ -> eν-bary can be obtained if the state with intermediate a/sub 1/-meson is taken into account. 15 refs.; 3 figs.

19830 (JINR-R—2-87-134) K-meson electromagnetic radius. Bejlin, V.A.; Nesterenko, V.A.; Radyushkin, A.V. (Rostovskij-na-Donu Gosudarstvennyj Univ., USSR; Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of Theoretical Physics). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701502/JAW.

Submitted to the journal Mod. Phys. Lett. .

The QCD sum rules for the kaon form factor at small Q/sup 2/ are obtained. The kaon charge radius is determined with a rather good accuracy and is in agreement with experiment. A sum rules for the difference <r/sub π//sup 2/>-<r/sub k//sup 2/> are obtained. 19 refs.

19831 (LAPP-TH—161) Multistring fragmentation model from ISR to SSC energies. Aurenche, P.; Bopp, F.W.; Ranft, J. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). May 1986. 16p. (CONF-8605163—8). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753200/JAW.

From Workshop on physics simulation at high energies; Madison, WI, USA (5 May 1986).

We report on a particle production model for soft hadronic collisions. The model is based on dual-Regge ideas and involves the production of strings which subsequently decay independently. The model is in agreement with the experimental features such as the rise with energy of the multiplicity and the rapidity plateau, the violations of KNO scaling, the forward-backward correlations... Extensions of the model to the semi-hard scattering region are proposed and shown to agree with the data on the rise of the transverse momentum of secondaries with the particle density in the central region at the CERN collider. The relevance of the model for mini-jet events is also discussed. Finally extrapolations to SSC energies are presented.

19832 (UWThPh—1987-28) Existence of hybrid states in chromostatics. Dreier, H.; Rupertsberger, H. (Vienna Univ., Austria. Inst. fuer Theoretische Physik). (Vienna Univ. (Austria)). 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701535/JAW.

Using Adler's chromostatics and the leading-logarithm, renormalization group improved Euclidean action for the gluon fields, it is shown that the color singlet hybrid state of quark-antiquark-gluon (qq-barg) should be as well defined as the corresponding meson (qq-bar), baryon (qqq) or glueball (gg) states. For simplicity the color gauge group is chosen to be SU(2). 6 refs.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 19848, 19998

19833 (LAPP-TH—143) Algebraic structure of chiral anomalies. Stora, R. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). Sep 1985. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753204/JAW.

I will describe first the algebraic aspects of chiral anomalies, exercising however due care about the topological delicacies. I will illustrate the structure and methods in the context of gauge anomalies and will eventually make contact with results obtained from

index theory. I will go into two sorts of generalizations: on the one hand, generalizing the algebraic set up yields e.g. gravitational and mixed gauge anomalies, supersymmetric gauge anomalies, anomalies in supergravity theories; on the other hand most constructions applied to the cohomologies which characterize anomalies easily extend to higher cohomologies. Section II is devoted to a description of the general set up as it applies to gauge anomalies. Section III deals with a number of algebraic set ups which characterize more general types of anomalies: gravitational and mixed gauge anomalies, supersymmetric gauge anomalies, anomalies in supergravity theories. It also includes brief remarks on σ models and a reminder on the full BRST algebra of quantized gauge theories.

19834 **(LYCEN—8671) What is new in the study of differential equations by group theoretical methods.** Winternitz, P. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Nov 1986. 21p. (CONF-8610110—4). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753195/JAW.

From 15. international colloquium on group theoretical methods in physics; Philadelphia, PA, USA (20 Oct 1986).

Several recent developments have made the application of group theory to the solving of differential equations more powerful than it used to be. The ones discussed here are: 1. The advent of symbol manipulating computer languages that greatly simplify the construction of the symmetry group of an equation 2. Methods of finding all subgroups of a given Lie symmetry group 3. The theory of infinite dimensional Lie algebras 4. The combination of group theory and singularity analysis.

19835 **(SLAC—321) A search for supersymmetric electrons with the Mark II detector at PEP [Positron Electron Project].** LeClaire, B.W. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Oct 1987. Contract AC03-76SF00515. 193p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE88004644/JAW.

An experimental search for selectrons, the supersymmetric partner of the electron, has been performed at the PEP storage ring at SLAC using the Mark II detector. The experimental search done was based upon hypothetical reaction in e^+e^- interactions at PEP center of mass energies of 29 GeV. In this reaction the selectrons, e-tilde, are assumed produced by the interaction of one of initial state electrons with a photon radiated from the other initial state electron. This latter electron is assumed to continue down the beam pipe undetected. The photon and electron then produce a selectron and a photino, γ-tilde, in the supersymmetric analog of Compton scattering. The photino is assumed to be the lightest supersymmetric particle, and as such, does not interact in the detector, thereby escaping detection very much like a neutrino. The selectron is assumed to immediately decay into an electron and photino. This electron is produced with large p perpendicular with respect to the beam pipe, since it must balance the transverse momentum carried off by the photinos. Thus, the experimental signature of the process is a single electron in the detector with a large unbalanced transverse momentum. No events of this type were observed in the original search of 123 pb^{-1} of data, resulting in a cross section limit of less than 2.4×10^{-2} pb (at the 95% CL) within the detector acceptance. This cross section upper limit applies to any process which produces anomalous single electron events with missing transverse momentum. When interpreted as a supersymmetry search it results in a lower selectron mass limit of 22.2 GeV/c^2 for the case of massless photinos. Limits for non-zero mass photinos have been calculated. 87 refs., 67 figs., 17 tabs.

19836 **(SLAC-PUB—4502) A short vademecum on CP violation in heavy flavor decays.** Bigi, I.I. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Dec 1987. Contract AC03-76SF00515. 5p. (CONF-8709224—2). NTIS, PC A02. Order Number DE88005496/JAW.

From B-meson factory workshop; Stanford, CA, USA (8 Sep 1987).

A short introduction into the phenomenology of CP asymmetries in beauty (and D^0) decays is given. Different experimental environments are briefly compared and some semiquantitative estimates listed.

6454 Field Theory

REFER ALSO TO CITATION(S) 19808, 19809

19837 **(ANL-HEP-CP—87-120) Diffraction theory in QCD and beyond.** White, A.R. (Argonne National Lab., IL (USA)). 11 Dec 1987. Contract W-31109-ENG-38. 18p. (CONF-8710274—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005958/JAW.

From 2. international conference on elastic and diffractive scattering; New York, NY, USA (15 Oct 1987).

A study of the Pomeron in QCD is briefly outlined. Implications for the production of W^+W^- and Z^0Z^0 pairs are described and the possibility that the electroweak scale is a major strong-interaction threshold discussed. The application of Pomeron phase-transition theory to SU(5) dynamical symmetry breaking is suggested and the related "strong-interaction" properties of the photon briefly mentioned.

19838 **(DOE/ER/40048—209-L7) Searches for forces weaker than gravity.** Adelberger, E.G. (Washington Univ., Seattle (USA). Dept. of Physics). 1987. Contract AC06-81ER40048. 12p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003579/JAW.

This paper discusses experiments that are searching for field particles associated with a new force that is weaker than gravity. (LSP)

19839 **(EFI—841(68)-85) Radiative decays of charmonium P-levels in quantum chromodynamics.** Dulyan, L.S.; Oganesyan, A.G.; Khodzhamiryan, A.Yu. (Erevanskij Fizicheskij Inst. (USSR)). 1985. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87702692/JAW.

The gluonic power corrections to quantum chromodynamics sum rules for $chi_b(3415)$ charmonium $^3P_0$-level radiative decays are calculated. The widths of $chi_b \to J/psi\gamma$, 2γ, $e^+e^-\gamma$ decays are predicted.

19840 **(IAE—4275/1) Galilei relativity principle in classical electrodynamics.** Kotel'nikov, G.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703203/JAW.

A theorem is formulated that Galilei group is that of Maxwell equation exact symmetry group, providing the fields are transformed by nonlinear representation of this group. Galilei symmetry differs from the relativistic one in the fact that relativistic symmetry is manifested while postulating the light velocity invariance, whereas Galilei symmetry is manifested during postulating time invariance. In relativistic case the field transformations are linear and global, in Galilei case they are nonlinear and evidently depend on time and coordinates. Existence of Galilei symmetry for Maxwell equations means that in a certain sense, Galilei relativity principle holds not only in classical mechanics but in classical electrodynamics too. 13 references.

19841 (INIS-mf—10911, pp 59) **Covariant calculation of rho -> π π decay in QCD using a 1/N/sub c/ colour expansion.** Praschifka, J.; Roberts, C.D.; Cahill, R.T. (Flinders Univ. of South Australia, Bedford Park). 1986. NTIS (US Sales Only), PC A06/MF A01. Order Number DE87702489/JAW. (CONF-860233—Absts.).

From 11. nuclear physics conference; Melbourne, Australia (3 Feb 1986).

19842 **(INP—1247/PL) Gauge invariance of macroscopic electrodynamics.** Kapuscik, E. (Institute of Nuclear Physics, Krakow (Poland)). 1984. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701348/JAW.

It is shown that the group of gauge transformations in electrodynamics is larger than that described in textbooks and literature. The proof rests on new representation of electromagnetic fields in terms of potentials.

19843 (INP—1251/PL) Self-consistent solutions of Yang-Mills-Dirac equations. Malec, E. (Institute of Nuclear Physics, Krakow (Poland)). 1984. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701350/JAW.

New periodic in time solutions of Yang-Mills-Dirac equations are obtained. Their stability is discussed.

19844 (ITEP—191(1986)) Statistical sum of bosonic string, compactified on an orbifold. Morozov, A.; Ol'shanetskij, M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701494/JAW.

Expression for statistical sum of bosonic string, compactified on a singular orbifold, is presented. All the information about the orbifold is encoded the specific combination of theta-functions, which the statistical sum is expressed through. 15 refs.; 1 tab.

19845 (JINR-E—2-87-279) Quantization of axial electrodynamics. Nguen Suan Han; Pervushin, V.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701498/JAW.

Submitted to the Intern. Conf. High Energy Phys., Sweden, 1987.

The possibility of constructing the Hamiltonian quantization for axial electrodynamics with anomalies in a four-dimensional space is studied. It is shown that in this theory the Jacobi identity for operators of the Hamiltonian, of a time component of the current and of the very field is broken. The usual quantum theory is consistent only for a zero magnetic field. 17 refs.

19846 (JINR-E—2-87-368) Secondary gauge conditions in field theory. Skachkov, N.B.; Shevchenko, O.Yu. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701499/JAW.

Submitted to the journal Theor. Math. Phys. .

It is shown that upon imposing one gauge condition on the gauge fields the latter turn out to obey the secondary gauge condition that in QED has the form of a Lorentz gauge condition. A new class of gauge-invariant and part-dependent non-Abelian fields is introduced. It is shown that all of the QED relations, i.e. the equations of motion, the formulae of the connection with the strength tensor, the secondary gauge condition etc., take place for these new fields with the only substitution of the ordinary derivatives by the Mandelstam ones. 13 refs.

19847 (JINR-R—2-87-363) Hamiltonian formalism in the model of the relativistic string with rigidity. Nesterenko, V.V.; Nguen Suan Han. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 16p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701503/JAW.

Submitted to the journal Int. J. Mod. Phys. A.

The model of the bosonic string with the Nambu - Goto action extended by the term, proportional to the external curvature of the world sheet is explored. The external curvature of the world-sheet is determined by the second order derivatives of the string coordinates. Thus the modified Lagrangian is a singular Lagrangian of second order. The canonical variables for this theory are introduced, constraints are found and Hamiltonian formulation of the classical dynamics in this theory is constructed. The transition to the quantum theory is briefly discussed. 18 refs.

19848 (KFTI—87-25) Particle in harmonic N=2 superspace. Akulov, V.P.; Bandos, I.A.; Sorokin, D.P. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1987. 15p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701514/JAW.

The action for particle dynamics in harmonic N=2 superspace is proposed, which contains one-dimensional CP/sup 1/ σ-model action with Wess-Zumino term. Quantization of the theory by means of the Gupta-Bleuler method is carried out. Quantum states being U(1)-charged analytic N=2 superfields describe all known N=2 matter hypermultiplets. 29 refs.

19849 (LBL—24114) Effective nonrenormalizable theories at one loop. Gaillard, M.K. (Lawrence Berkeley Lab., CA (USA)). 12 Oct 1987. Contract AC03-76SF00098. 22p. (CONF-8708196—1; UCB-PTH—87/44). NTIS, PC A03. Order Number DE88003897/JAW.

From School on particle physics; Cargese, Italy (4 Aug 1987).

The paper focuses on a nonrenormalizable theory that is more closely related to those suggested by superstrings, namely a gauged nonlinear δ-model, but one which can also be obtained analytically in a particular limit of a parameter (m/sub H/ $\rightarrow \infty$) of the standard, renormalizable electroweak theory. This will provide another laboratory for testing the validity of calculations using the effective theory. We find (as for certain superstring inspired models to be discussed later) features similar to those for the Fermi theory: quadratic divergences can be reinterpreted as renormalizations, while new terms are generated at the level of logarithmic divergences. Also introduced in the context of more familiar physics are notions such as scalar metric, scalar curvature and nonlinear symmetries, that play an important role in formal aspects of string theories. 58 refs., 12 figs.

19850 (NORDITA—87/34-P(prepr.)) C-disorder fields and twist partition functions in parafermionic conformal field theories. Ravanini, F.; Yang, S.K. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Jun 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752293/JAW.

The character formulae for the C-disorder fields corresponding to the charge conjugation symmetry in the parafermionic conformal field theories of Zamolodchikov and Fateev are obtained. These characters span a unitary representation of the level 2 subgroup of the full modular group. The corresponding twist partition functions are calculated. Derivation of the character formula is based on the relation between the parafermionic theories and the twisted N=2 superconformal algebra. A similar idea is applied to explicitly construct the highest weight modules of the twisted SU(2) Kac-Moody algebra.

19851 (SLAC-PUB—4491) Measurement of the mass and lifetime differences between the heavy and light B/sub s/ eigenstates. Dunietz, I. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)). Nov 1987. Contract AC03-76SF00515. 6p. (CONF-8711128—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005497/JAW.

From Workshop on high sensitivity beauty physics at Fermilab; Batavia, IL, USA (11 Nov 1987).

This report concerns measurements of the mass and lifetime differences of the B/sub s/ - anti B/sub s/ system. A large mass difference, (DELTA m/gamma)/sub B//sub s/ greater than or equal to 5, is predicted in the Kobayashi-Maskawa (KM) model with three generations of quarks. This prediction follows from two factors. The first is the ARGUS collaboration report of a large B/sub d/ - anti B/sub d/ mixing, (DELTA m/gamma)/sub B//sub d/ approxi.1. The second is the unitarity of the 3 x 3 KM matrix. The prediction does not depend whether the KM model is relevant for CP violation. Thus, a much smaller (DELTA m/gamma)/sub B//sub s/ $<<$ 5 would indicate new physics. An argument for an observable lifetime difference will be given. This report discusses time-dependent ways to extract the mass difference and lifetime difference of the neutral B/sub s/ system.

19852 (UWThPh—1987-30) On Pinl's representation of null curves in n dimensions. Urbantke, H. (Vienna Univ., Austria. Inst. fuer Theoretische Physik). (Vienna Univ. (Austria)). 1987. 4p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701536/JAW.

It is known that the world sheets of classical strings are generated by parallel translation of a null curve along another null curve. Here a representation of null curves in n dimensions, due to Max Pinl (1936), is pointed out for possible benefit of workers in this field. 4 refs.

19853 **Poisson algebra of the invariant charges of the Nambu-Goto theory: Casimir elements.** Pohlmeyer, K. (California Univ., Berkeley, USA. Dept. of Physics; Lawrence Berkeley Lab., CA, USA). *Communications in Mathematical Physics;* **114**: No. 3, 351-362(Feb 1988). Contract AC03-76SF00098.

The reparametrization invariant "non-local" conserved charges of the Nambu-Goto theory form an algebra under Poisson bracket operation. The center of the formal closure of this algebra is determined. The relation of the central elements to the constraints of the Nambu-Goto theory is clarified.

19854 **Two-loop dilation tadpole induced by Fayet-Iliopoulos D-terms in compactified heterotic string theories.** Atick, J.J.; Sen, A. (Stanford Linear Accelerator Center, CA, USA). *Nuclear Physics [Section] B;* **296**: No. 1, 157-186(4 Jan 1988). Contract AC03-76SF00515.

We calculate the two-loop dilaton tadpole induced by Fayet-Iliopoulos D-terms in heterotic string theories compactified on arbitrary supersymmetry preserving backgrounds. The result turns out to be a total derivative in the moduli and hence receives contribution solely from the boundary of the moduli space. This contribution is shown to be proportional to the square of the coefficient of the one-loop Fayet-Iliopoulos D-term in agreement with what is expected from effective lagrangian considerations.

19855 **Study of the chiral transition in U(1) lattice gauge-Higgs theory with fermions.** Lee, I.H.; Shrock, R.E. (Brookhaven National Lab., Upton, NY, USA. Physics Dept.; State Univ. of New York, Stony Brook, USA. Inst. for Theoretical Physics). *Nuclear Physics B, Field Theory Statistical Systems;* **290**: No. 3, 275-290(30 Nov 1987). Contract AC02-76CH00016.

Using Monte Carlo methods, we study the (zero-temperature) chiral phase transition in 4D U(1) lattice gauge-Higgs theory with fermions of charge q/sub f/ = 1 and 2. We report the first comparison between Monte Carlo data and analytic results (applicable at strong gauge coupling), and find very good agreement. In the interior of the phase diagram, the chiral transition is observed to coincide with the confinement-Higgs phase boundary for q/sub f/ = 1 and to occur at larger β/sub h/ for q/sub f/ = 2.

19856 **Weak neutralino decays of an extra Z boson.** Nandi, S. (Oklahoma State Univ., Stillwater, USA. Dept. of Physics; Fermi National Accelerator Lab., Batavia, IL, USA). *Physics Letters [Section] B;* **197**: No. 1/2, 144-148(22 Oct 1987). Contract FG05-85ER40215.

We calculate the decay widths of an extra Z boson (Z/sub 2/) into a pair of weak neutralinos in superstring inspired SU(2)xU(1)xU'(1) gauge theories. If kinematically allowed, the branching ratio can be as large as about sixteen percent. Subsequent decays of these neutralino pairs give rise to multilepton events (four charged leptons with high p/sub T/) which will be an interesting signal for supersymmetry.

19857 **Conformal field theories with first-order lagrangians.** Sonoda, Hidenori. (Lawrence Berkeley Lab., CA, USA). *Physics Letters [Section] B;* **197**: No. 1/2, 167-173(22 Oct 1987). Contract AC03-76SF00098.

Conformal field theories with first-order lagrangians, the so-called bc-systems, are solved completely for both Fermi and Bose statistics. We show that the conformal properties of the fields determine the correlation functions of the theories uniquely. We also prove the validity of Wick's rule for multi-correlation functions.

65 PHYSICS II

6510 Nuclear Physics

REFER ALSO TO CITATION(S) 18374, 19799, 19935, 19986, 20250, 20251

19858 **(BARC—1335) Development of a computer program to draw the energy level diagram of a nuclide using CALCOMP plotter.** Rattan, S.S. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703143/JAW.

A computer program to develop the energy level diagram of a nuclide using CALCOMP plotter is described. In order to modify or to draw a new energy level diagram only the input data file requires to be changed. The labels and heading can be written at appropriate places as required. Example of input data file for data and program listing are included in the report. Since the subroutine used in the program are common, this computer program can be used on any computer system.

19859 **(BARC—1353) Neutron radiative capture cross section of /sup 232/Th in the energy range 0.1 to 1.2 MeV.** Jain, H.M.; Kailas, S. (Bhabha Atomic Research Centre, Bombay (India)). 1987. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701238/JAW.

Recently reported neutron radiative capture cross section of /sup 232/Th measurements in the energy range 0.1 to 1.2 MeV are compared with the calculations based on the statistical model Hauser-Feshbach theory using the spherical optical model transmission coefficients and simple Fermi gas level density formula. The calculations are in good agreement with the recent experimental data, reproducing both the absolute magnitude and the shape exhibited by the excitation function. The results of this comparative study can be used for improving the evaluation of the neutron radiative capture cross section of /sup 232/Th. 16 refs., 3 tables, 4 figures.

19860 **(BARC—1366) Measurement and analysis of alpha induced reaction on Ta, Ag and Co.** Ismail, M.; Divatia, A.S. (Bhabha Atomic Research Centre, Calcutta, India. Variable Energy Cyclotron Project). (Bhabha Atomic Research Centre, Bombay (India)). 1987. 18p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701408/JAW.

Excitation functions for the reaction /sup 181/Ta(α,xn)sup(181-x)Re, sup(107,109)Ag(α,ypxn) and /sup 59/Co(α,ypxn) were obtained from measurements of residual activity of stacked foils from threshold to 60 MeV. The excitation functions for the production of /sup 181/Re, /sup 182/Re, /sup 183/Re, /sup 184/Re, /sup 105/Ag, /sup 111/In, /sup 54/Mn, /sup 56/Co, /sup 58/Co, and /sup 60/Co, are being presented. The experimental data are compared with calculations considering equilibrium as well as pre-equilibrium reactions according to the hybrid model of Blann. High energy part of the excitation functions are dominated by the pre-equilibrium reaction mechanism. Calculations were done using a priori calculational method of Overlaid Alics Code of Blann. Most of the excitation functions in the energy range mentioned above could be very well fitted with the hybrid model calculation for exciton number n=4 with nsub(p)=2 and nsub(n)=2. The overall agreement with theory is good. Certain discrepancies, however, indicate the necessity to revise the hybrid model with respect to emission of complex particles. 4 tables, 13 figures, 31 refs.

19861 **(BARC—1377) Progress report on nuclear data activities in India for the period from January 1986 to June 1987.** Anand, R.P. (comp.; Bhabha Atomic Research Centre, Bombay, India. Nuclear Physics Div.). (Bhabha Atomic Research Centre, Bombay (India)). 1987. 75p. NTIS (US Sales Only), PC A04/MF A01. Order Number TI88701415/JAW.

The present progress report on Nuclear Data Activities in India is the fifth in the current new series of progress reports, the first of which was brought out in the year 1981. This report covers the period from January 1986 to June 1987. It contains information about measurements, evaluations, complilations and processing of

nuclear data and other related works being carried out mainly at Bhabha Atomic Research Centre, Bombay and Indira Gandhi Centre for Atomic Research, Kalpakkam, the two nuclear and reactor research Centres in this country. It may be worth mentioning here that an IAEA interregional training course on 'Processing of Nuclear Data for Use in Reactor Applications' was held at Bhabha Atomic Research Centre, Bombay during 31 March - 25 April 1986. This course was designed to provide participants with a working knowledge of the methods currently used to process nuclear data for use in reactor applications. It comprised of lectures as well as computer exercises. The scope of the course included an introduction to currently available nuclear data libraries and their applications in specific reactor applications, processing of resonance parameters, Doppler broadening, the multigroup method and self-shielding. It also included the lectures on the accuracy of the results obtained and on the sensitivity analysis, which can be used to determine the sensitivity of the integral reactor parameters to nuclear data uncertainties.

19862 **(DOE/ER/40048—200-L7) Nuclear Physics Laboratory: Annual report.** (Washington Univ., Seattle (USA). Nuclear Physics Lab.). May 1987. Contract AC06-81ER40048. 98p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88004118/JAW.

Topics covered in this annual report are: astrophysics and cosmology, giant resonances in excited nuclei, heavy ions, fundamental symmetries, nuclear reactions, accelerator mass spectrometry, accelerators and ion sources, nuclear instrumentation, computer systems and the booster linac project.

19863 **(EFI—859(10)-86) Inclusive spectra of He, Li, Be, B fragments produced on nuclei by electrons with energies of 2 and 4.5 Gev at angles 50 and 130°.** Ajvazyan, G.M.; Arutyunyan, V.N.; Akhverdyan, Eh.A. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703147/JAW.

By means of ΔE-E semiconductor technique the inclusive energy spectra of He, Li, Be, B fragments (in their energy range of — 4-8 MeV/nucleon) produced on Be, Al, Ni, Cu, Ag, Au nuclei by electrons with energies of 2 and 4.5 GeV at angles 50 and 130 deg have been obtained. A comparison is made with the energy spectra of fragments obtained on proton beams and from the calculations by snowball model.

19864 **(FEI—1683) Automated operator's position for measurements of neutron cross sections on the base of the SM-3 mini-computer and the CAMAC system.** Kharitonov, A.K.; Druzhinin, V.I.; Lukashkin, A.V.; Rusanov, V.A.; Davletshin, A.N.; Tipunkov, A.O.; Tikhonov, S.V.; Tuzhilov, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703150/JAW.

To conduct nuclear-physical experiments with almost monochromatic neutrons an automated operator's position in the CAMAC standard on the basis of the SM-3 computer is constructed. The complex development permitted to automatize the processes of measurement and processing of experimental data to a considerable extent. The automated operator's position was used to determine energy spectra and flux of almost monochromatic neutrons in the given point of space and changes in the spectra and flux in time. The block-diagram of the measuring complex and computer codes for experiment control are described. Various operation modes of the system, as well as principles of constitution and software possibilities are considered. 5 references, 3 figures.

19865 **(TRI-PP—87-73) Summary remarks.** Vogt, E. (TRIUMF, Vancouver, British Columbia (Canada)). Oct 1987. 7p. (CONF-8708102—12). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88900276/JAW.

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

This paper contains an overview of a conference on pion-nucleus physics. Discussed in this paper are the standard model, fundamental interactions involving the pion and the nucleus, and the need for higher energy pion beams and meson beams and their detectors. (LSP)

19866 **Pion-nucleus physics: Future directions and new facilities at LAMPF [Los Alamos Meson Physics Facility].** Peterson, R.J.; Strottman, D.D. (eds.). New York, NY; American Institute of Physics (1988). 589p. (CONF-8708102—). American Institute of Physics, 335 E 45th Street, New York, NY 10017. Order Number TI88005469/JAW. Contract W-7405-ENG-36.

From Pion nucleus physics: future directions and new facilities at LAMPF workshop; Los Alamos, NM, USA (17 Aug 1987).

A large-scale workshop was convened at Los Alamos National Laboratory to begin planning for new experimental methods, instruments, and facilities to study pion-nucleus interactions. Invited talks either presented current understandings or pointed out powerful experimental tools that could be used. The workshop consisted of nine topical sessions entitled Few-Body Questions, Charge Exchange Reactions, Heavier Mesons, Low Energy Pion Reactions, Pion Absorption, Physics in the Continuum, Nuclear Structure, Deltas in Nuclei, and Open Questions. The thirty nine papers presented in these sessions have been abstracted separately. (DWL)

6512 Nuclear Properties And Reactions, A=1-5, Experimental

19867 **Limit on ν-bar/sub e/ mass in free molecular tritium beta decay.** Bowles, T.J.; Browne, J.C.; Maley, M.P.; Robertson, R.G.H.; Wilkerson, J.F.; Knapp, D.A.; Helfrich, J.A. (Physics Div., Los Alamos National Lab., Los Alamos, NM 87545). pp 304-314 of Nuclear beta decays and neutrino. Kotani, T.; Ejiri, H.; Takasugi, E. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8606205—).

From International symposium on nuclear beta decay and neutrinos; Osaka, Japan (11 Jun 1986).

The beta spectrum of the decay of free molecular tritium has been accurately measured in order to search for a finite ν-bar/sub 3/ mass. The final state effects in molecular tritium are accurately known and the data thus yield an essentially model independent upper limit of 29 eV on the ν-bar/sub e/ mass at the 95% confidence level.

6513 Nuclear Properties And Reactions, A=6-19, Experimental

19868 **(ANL/NDM—103) Spectrum of neutrons emitted from a thick beryllium target bombarded with 7 MeV deuterons.** Smith, A.; Guenther, P.; Micklich, B. (Argonne National Lab., IL (USA); Illinois Univ., Urbana (USA)). Jan 1988. Contract W-31109-ENG-38. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005670/JAW.

The spectrum of neutrons emitted from a thick beryllium target bombarded with 7 MeV deuterons is measured at 25 reaction angles distributed between 0° and 158°, and over the neutron energy range ≈<0.8 to >11.0 MeV. The spectrum is determined relative to the standard ^{252}Cf prompt-fission-neutron-spectrum using fast time-of-flight techniques. The results are presented as angle-energy differential distributions and as relative numerical group cross sections suitable for establishing a reference field for applied studies. 24 refs., 4 figs.

19869 **(INIS-mf—11602) Resonances in the proton-/sup 6/Li scattering.** Haller, M. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Naturwissenschaftliche Fakultaet 1 - Mathematik und Physik). 22 Dec 1986. 129p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751927/JAW.

The differential cross section and the analyzing power of the p+/sup 6/Li scattering were measured in the laboratory energy range from 1.6 respectively 2.8 MeV to 10 MeV at 45 respectively 40 energies in full angular distributions. The data were subjected both to an analysis in the optical model which yielded already hints to resonance effects and to a comphrehensive scattering-phase analysis for L=0, 1, and 2 under inclusion of channel spin and orbital

angular momentum mixings. The consistent description of all data required the assumption of broad resonance structures. An approximate parametrization by a Breit-Wigner formula allowed the estimation of the resonance parameters. (orig./HSI).

19870 **Investigation of thick-target neutron emission from Be-9(d,n)B-10 at Esub(d)=7 MeV for angles other than zero degrees.** Smith, D.L.; Meadows, J.W.; Guenther, P.T. (Argonne National Lab., IL, USA). *Radiation Effects;* **95**: No. 1-4, 285-289(1986). (CONF-850507—).

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

Double-differential measurements of neutron emission from a thick beryllium target bombarded with 7-MeV deuterons are made for neutrons above 800 keV, over the angular range of 0 to 155 deg. The angular dependence of the neutron yield is found to be quite anisotropic. The importance of this anisotropy in integral neutron-induced reaction cross-section investigations is illustrated.

6514 Nuclear Properties And Reactions, A=20-38, Experimental

19871 **(BNL—40551) (p,n) systematics and the cosmological connection.** Ward, T.E.; Breeden, J.; Porter, R. (Brookhaven National Lab., Upton, NY (USA); Indiana Univ. Cyclotron Facility, Bloomington (USA)). 1987. Contract AC02-76CH00016. 17p. (CONF-871259—1; BNL/NPB—87-111). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005031/JAW.

From American Chemical Society meeting; Little Rock, AR, USA (3 Dec 1987).

Inclusive measurements of (p,n) reactions at intermediate energies of 50 to 1000 MeV have yielded new information in recent years on the energy and target mass dependence for direct interactions in (p,n) reactions. Furthermore, central collision processes can add appreciably to the inelastic cross-section at intermediate energy producing intermediate mass fragments (IMF) in substantial yields at energies above 200 MeV. These systematics are of much value for interpreting cosmic-ray exposure times, alteration of elemental abundances, and cosmological processes. 59 refs., 4 figs.

19872 **(INIS-mf—10785) Nuclear molecules in the systems /sup 12/C+/sup 12/C and /sup 16/O+/sup 16/O.** Tiereth, W. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Naturwissenschaftliche Fakultaet 1 - Mathematik und Physik). 17 Nov 1986. 145p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751920/JAW.

For the two heavy ion systems /sup 12/C+/sup 12/C and /sup 16/O+/sup 16/O by means of scattering experiments studies on the phenomena of nuclear molecules were performed. For the /sup 12/C+/sup 12/C system in the range of the Coulomb wall precision measurements of the elastic scattering were performed. In the two energy ranges of 5.5 ≦ E/sub c.m./ ≦ 6.65 MeV and 6.95 ≦ E/sub c.m/ ≦ 7.375 MeV where the existence of many quasimolecular resonances is known in energy steps of ΔE/sub c.m./ = 25 keV angular distributions in the range 10/sup 0/ ≦ θ/sub c.m./ ≦ 90/sup 0/ with Δθ/sub c.m./ = 1/sup 0/ were measured. For several of the found quasimolecular resonances the spin and the carbon width could be uniquely determined. This was reached by a partial wave analysis of the obtained data. Supplemented were the measurements of the elastic scattering by measurements of the excitation function of the θ/sub 0/ exit channel of the reaction /sup 12/(/sup 12/C, θ)/sup 20/Ne in the energy range from 5.2 ≦ E/sub c.m./ ≦ 6.1 MeV. At some known resonances in the /sup 16/O+/sup 16/O system in the energy range from 15.5 MeV to 18 MeV the spin and the elastic width of these structures could be determined. For this a constrained partial wave analysis on complete angular distributions of the elastic scattering (9/sup 0/ ≦ θ/sub c.m./ ≦ 90/sup 0/) which were measured in energy steps of ΔE/sub c.m./ = 50 keV was performed. In the /sup 16/O+/sup 16/O system besides the proof for the existence of a nuclear glory scattering was given.

6515 Nuclear Properties And Reactions, A=39-58, Experimental

19873 **(DOE/ER/40048—195-L7) Spin dependence of the giant dipole resonance strength function in highly excited nuclei in the mass region A = 39 - 45.** Kicinska-Habior, M.; Behdr, J.A.; Gossett, C.A.; Gundlach, J.H.; Feldman, G.; Snover, K.A. (Washington Univ., Seattle (USA)). 1987. Contract AC06-81ER40048. 3p. (CONF-8709200—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004111/JAW.

From 1. topical meeting on giant resonance excitation in heavy-ion collisions; Legnaro, Italy (21 Sep 1987).

In order to study measured continuum γ-ray spectra from decays of $^{39}K^*$, $^{40}K^*$, $^{43}Ca^*$ and $^{45}Sc^*$ compound nuclei produced by heavy-ion-fusion reactions. For such light compound nuclei, the effective temperature associated with the states upon which the GDR is built is nearly constant or even decreases with increasing projectile energy in the entrance channel for projectiles of mass A on the order of 12 to 18. 3 refs., 2 figs.

19874 **(ORNL—6418) Gamma-ray decay of levels in ^{53}Cr.** Dickens, J.K.; Larson, D.C. (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006138/JAW.

Gamma-ray decay of levels in the stable isotope ^{53}Cr has been studied using ^{53}Cr(n,n'γ) reactions for incident neutron energies between threshold and 10 MeV. Of the 65 gamma rays or gamma-ray groups observed for neutron interactions with ^{53}Cr, 50 have been placed or tentatively placed among 34 levels in ^{53}Cr up to an excitation energy of 4.36 MeV. Deduced branching ratios are in reasonable agreement with previous measurements except for decay of the E/sub x/ = 1537-keV level. For the decay of the E/sub x/ = 1537-keV level we are unable to explain variations in the branching ratios of the transition gamma rays as a function of incident neutron energy within the framework of the presently known level structure of ^{53}Cr and suggest the possibility of a second energy level at E/sub x/ = 1537 keV. 59 refs., 13 figs., 2 tabs.

19875 **Calculated neutron-induced cross sections for sup(63,65)Cu, sup(58,60)Ni, and ^{52}Cr from 1 to 20 MeV and comparisons with experiments.** Hetrick, D.M.; Fu, C.Y.; Larson, D.C. (Oak Ridge National Lab., TN, USA). *Radiation Effects;* **95**: No. 1-4, 191-194(1986). (CONF-850507—). Contract AC05-84OR21400.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

Nuclear model codes were used to compute cross sections for neutron-induced reactions on sup(63,65)Cu, sup(58,60)Ni, and ^{52}Cr for incident energies from 1 to 20 MeV. The input parameters for the model codes were determined through analysis of experimental data in this energy region. The models used, the input data, the resulting calculations, and comparisons with measured data are discussed.

6516 Nuclear Properties And Reactions, A=59-89, Experimental

19876 (IA—1427, pp 126-127) **Isomerism in /sup 83/Zr and /sup 83/Y and the low-energy level structure of /sup 83/Y.** Rapaport, M.S.; Liang, C.F.; Paris, P. (Israel Atomic Energy Commission, Tel Aviv; Paris-11 Univ., 91 - Orsay, France. Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19877 **(INIS-mf—10793) Study of the angular monentum dissipation in the system /sup 32/S+/sup 64/Ni in deep inelastic collisions.** Keller, K. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1986. 53p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751921/JAW.

In the present thesis energy and angular correlations of neutrons with deep-inelastically scattered projectile-like fragments (PLF) were studied. A detailed kinematic analysis resulted that the detected neutrons can nearly completely be assigned to the evaporation of the heavy recoil nuclei. The temperatures of the target-like fragments (TLF) and the neutron multiplicities indicate a mass-proportional partition of the excitation energy to PLF and TLF. A study of the spectra and correlations in the framework of the statistical model allows an estimation of the mean spin and the widths of the spin distributions for the TLF. The results are compatible with the assumption of a rigid rotation of the dinuclear system (sticking) at entrance angular momenta around 1/sub crit/. The widths of the spin distribution favour a nearly complete alignment of the dissipated angular momentum.

19878 (LA—11233-T) Theoretical and experimental cross sections for neutron reactions on ^{64}Zinc. Rutherford, D.A. (Los Alamos National Lab., NM (USA)). Mar 1988. Contract W-7405-ENG-36. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005896/JAW.

Accurate measurements of the ^{64}Zn (n,2n)^{63}Zn and ^{64}Zn (n,p)^{64}Cu cross sections at 14.8 MeV have been made using a Texas Nuclear Neutron Generator and the activation technique. A NaI(Tl) spectrometer (using two 6" x 6" NaI detectors/crystals) was ued to measure the gamma radiation emitted in coincidence from the positron-emitting decay products. The measurements were made relative to ^{65}Cu (n,2n)^{64}Cu and ^{63}Cu (n,2n)^{62}Cu cross sections, which have similar half-lives, radiation emission, and were previously measured to high accuracy (2%). The value obtained for the (n,2n) measurement was 199 +- 6 millibarns, and a value of 176 +- 4.5 millibarns was obtained for the (n,p) measurement. In concert, a theoretical analysis of neutron induced reactions on ^{64}Zn was performed at Los Alamos National Laboratory using the Hauser-Feshbach statistical theory in the GNASH code over an energy range of 100 keV to 20 MeV. Calculations included width fluctuation corrections, direct reaction contributions, and preequilibrium corrections above 6 MeV. Neutron optical model potentials were determined for zinc. The theoretical values agree with the new 14.8 MeV measurements approximately within experimental error, with calculations of 201 millibarns for the (n,2n) cross section and 170 millibarns for the (n,p) cross section. Results from the analysis will be made available in National Evaluated Nuclear Data Format (ENDF/B) for fusion energy applications. 50 refs., 34 figs., 10 tabs.

19879 New limits for double-beta-decay lifetimes in /sup 76/Ge. Caldwell, D.O.; Eisberg, R.M.; Grumm, D.M.; Hale, D.L.; Witherell, M.W.; Goulding, F.S.; Landis, D.A.; Madden, N.W.; Malone, D.F.; Pehl, R.H. (Physics Dept., Univ. of California, Santa Barbara, CA 93106). pp 103-110 of Nuclear beta decays and neutrino. Kotani, T.; Ejiri, H.; Takasugi, E. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8606205—).

From International symposium on nuclear beta decay and neutrinos; Osaka, Japan (11 Jun 1986).

New limits can be set on light an very heavy Majorana neutrino masses, on Majoron-neutrino coupling, and on right-handed currents from lifetime limits for double beta decay in /sup 76/Ge: 4.1x10/sup 23/y (68% C.L.) for 0/sup +/→ 0ν decay, 1.3x10/sup 23/y (68% C.L.) for 0/sup +/→2/sup +/ 0ν decay, 6x10/sup 20/y (90% C.L.) for 0ν with Majoron emission, and 8x10/sup 19/y (90% C.L.) for 2ν decay. These data were obtained for different time periods from 4, 6, and 8 Ge detectors in an active NaI shield.

6517 Nuclear Properties And Reactions, A=90-149, Experimental

19880 (DOE/ER/40048—208-L7) Giant nuclear resonances. Snover, K.A. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). 1987. Contract AC06-81ER40048. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004260/JAW.

Giant nuclear resonances are elementary modes of oscillation of the whole nucleus; they have characteristic oscillation energies in the range typically 10-30 MeV. In the giant dipole resonance (GDR), the protons and neutrons oscillate with opposite phase, producing a time-varying electric dipole moment which acts as an effective antenna for radiating gamma rays. Other giant modes such as electric monopole and quadrupole have also been identified in nuclei. Recently studies of the giant dipole resonance have been extended to highly excited "hot" nuclei. These new studies are providing unique new information about the properties of excited nuclei, in particular their shape. 7 refs., 2 figs.

19881 (ITEF—173(1986)) Some peculiarities of /sup 125m/Te gamma radiation. Alpatov, V.G.; Bizina, G.E.; Davydov, A.V. and others. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701492/JAW.

Experimental indications of resonance reaction (γ, 2γ) on nuclei of /sup 125m/Te long-lived isomer in the Moessbauer conditions are obtained. The process was detected by the appearance of the peak in gamma-quanta spectrum, which corresponds to simultaneous detection of two photons. 5 refs.; 1 fig.

19882 (LYCEN—8625) Identification of new proton-rich rare earth nuclei by means of the coupled system helium jet-isotope separator of SARA. Ollivier, T. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). 1986. 82p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87753194/JAW.

In order to study new exotic nuclei far from stability we built a fast separation system by coupling a helium jet with the medium-current source of the mass separator. First the tests were made in Lyon and then the system used on line with the heavy ion accelerator SARA, in Grenoble. We obtained efficiency greater than 1% for each element and a better chemical independence. This allowed us to perform experiments on rare-earth region near N=82, with fusion-evaporation reactions after an investigation of various ranges of beam energies. The first results allow to identify two new isotopes, /sup 143/Tb (12s) and /sup 138/Eu (12s). The decay schemes obtained are analysed in the frame of existing models.

19883 Beta-gamma decay of /sup 115/In and double-beta decay of /sup 96/Zr. Pacheco, A.F.; Strottman, D. (Theoretical Div., Los Alamos National Lab., Los Alamos, NM 87545). pp 197-203 of Nuclear beta decays and neutrino. Kotani, T.; Ejiri, H.; Takasugi, E. Teaneck, NJ; World Scientific Pub. Co. (1986). (CONF-8606205—).

From International symposium on nuclear beta decay and neutrinos; Osaka, Japan (11 Jun 1986).

The authors computed the beta-gamma decay width of /sup 115/In, the formalism of which is similar to that of double-beta decay. This compound transition, through both the first and second excited levels of /sup 115/Sn, has a branching ratio of about 10/sup -6/ with respect to the dominant β/sup -/ decay, and it causes an additional background if /sup 115/In is used as a solar neutrino detector. Large scale shell model calculations have been initiated for /sup 96/Zr and initial results for the double-beta decay to /sup 96/Mo are given.

6518 Nuclear Properties And Reactions, A=150-189, Experimental

19884 (EGG-PHY—7569) Decay of ^{150}Tb. Helmer, R.G.; Reich, C.W.; Bunker, M.E.; Starner, J.W. (EG and G Idaho, Inc., Idaho Falls (USA); Los Alamos National Lab., NM (USA)). Oct 1987. Contract AC07-76ID01570. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005502/JAW.

The decay of $_{65}{}^{150}$Tb (3 h) to levels in $_{64}{}^{150}$Gd has been studied by means of γ-ray singles and γ-γ coincidence spectroscopy. Approximately 500 γ-ray transitions have been observed in this decay. About 300 of these have been placed in a proposed level scheme for ^{150}Gd, consisting of 96 excited states. From the γ-ray intensity imbalances at each level, electron-capture and positron populations and the corresponding log ft values are computed. Possible spin and parity assignments are given for these levels. Com-

ments are made on the ambiguities, experimental and interpretational, involved in this study that are caused both by the inability to analyze the complex γ-ray spectrum correctly and completely and by the high density of the states resulting from the large Q/sub β/ value (4.76 MeV). 38 refs., 7 figs., 16 tabs.

19885 (LPNHEX-T—86-03) Study of the transverse momentum distribution of muon pairs produced in the π/sup -/ W interactions at 194 and 284 GeV/c. Frazao Bordalo e SA, M.P. (Ecole Polytechnique, 91 - Palaiseau (France). Lab. de Physique Nucleaire et des Hautes Energies). Jun 1986. 217p. (In French). NTIS (US Sales Only), PC A10/MF A01. Order Number DE87753207/JAW.

This thesis studies the inclusive muon pair production induced by 194 and 284 GeV/c π/sup -/ beam interacting on a tungsten target using the NA10 spectrometer at CERN SPS. The enormous statistical sample allowed us, for the first time, the measurement of the double and triple cross sections 1/P/sub T/ d/sup 2/ σ/dP/sub T/dM and 1/P/sub T/ d/sup 2/σ/dP/sub T/dMdy and the measurement of P/sub T//sup 2/ mean value as a function of M, y and S. The QCD predictions including soft gluons resummation agree with our results in some specific cinematic regions, however deviations are found at large mass and rapidity. We have observed, as well for the first time, scaling violations in the cross section S/sup 2/P/sup 2//sub T/d/sup 2/σ/dP/sup 2//sub /Tdm/sup 2/ as a function of XT=2P/sub T//√S and in the measurement of < P/sup 2//sub T/ >/ M/sup 2/ as function of √T; these results are in agreement with the QCD predictions.

6519 Nuclear Properties And Reactions, A=190-219, Experimental

19886 (LPCC-T—8602) Semi-exclusive study of the reaction /sup 40/Ar + /sup 197/Au at 35 MeV/u. Comparison with a participant-spectator model. Harasse, J.M. (Caen Univ., 14 (France). Lab. de Physique Corpusculaire). Jul 1986. 75p. (In French). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87753209/JAW.

The Ar+Au reaction has been studied at the GANIL accelerator at 35 MeV per nucleon. Target like nuclei and complete and incomplete fusion residues were detected by a time of flight telescope composed of solid detectors. Fission products were detected in coincidence, one of them by the time of flight telescope and the second one in a position sensitive parallel plate avalanche counter. Forward emitted light nuclei were detected (in the angular range 3/sup 0/-30/sup 0/) in coincidence either with a heavy residue or with two fission products by a multidetector constituted of 96 thin scintillator sheets allowing charge identification. The main results are the following: the residue velocity spectrum increases monotonically toward small velocities: the incomplete fusion bump still present in the residue velocity spectrum of the same reaction at 27 MeV/A has desappeared; the fission products angular correlation exhibits two peaks of similar amplitudes: the first one is linked to peripheral interactions, the second one to incomplete fusion. The heavy residues characteristics (mass, angle, velocity) are compatible with the predictions of a participant spectator model including reabsorption in the target of some of the participant nucleons (Bondorf model). However, the comparison between the experimental and predicted light particle velocity spectra allows to exclude the existence of an autonous participant zone. 29 refs.

6520 Nuclear Properties And Reactions, A=220 And Above, Experimental

19887 (ORNL/TM—10666) High energy resolution measurement of the ^{238}U neutron capture yield from 1 keV to 100 keV. Macklin, R.L.; Perez, R.B.; de Saussure, G.; Ingle, R.W. (Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006144/JAW.

The purpose of this work is the precise determination of the ^{238}U neutron capture yield (i.e., the probability of neutron absorption) as a function of neutron energy with the highest available neutron energy resolution. The motivation for this undertaking arises from the central role played by the ^{238}U neutron capture process in the calculation of the neutron balance of both thermal reactors and fast breeder reactors. The present measurement was performed using the Oak Ridge Electron Linear Accelerator (ORELA) facility. The pulsed beam of neutrons from the ORELA facility is collimated on a sample of ^{238}U. The neutron capture rate in the sample is measured, as a function of neutron time-of-flight (TOF), by detecting the gamma rays from the ^{238}U(n,γ)^{239}U reaction with a large gamma-ray detector surrounding the ^{238}U sample. At each energy, the capture yield is proportional to the observed capture rate divided by the measured intensity of the neutron beam. The constant of proportionality (the normalization constant) is obtained as the ratio of theoretical to experimentally measured areas under small ^{238}U resonances where the resonance parameters have been determined from high resolution ^{238}U transmission measurements. The cross section for the reaction ^{238}U(n,γ)^{239}U can be derived from the measured capture yield if one applies appropriate corrections for multiple scattering and resonance self-shielding. The present work will allow the extension of the resolved resonance region in ^{238}U from its current limit of 4 keV up to 20 keV. In addition, some 200 ^{238}U neutron resonances in the energy range from 250 eV to 10 keV have been observed which had not been detected in previous measurements. These results are relevant for both reactor design and for the understanding of the structure of the (^{239}U + n) compound nucleus. 33 refs., 20 figs., 9 tabs.

19888 History and analysis of the discovery of elements 104 and 105. Hyde, E.K.; Hoffman, D.C.; Keller, O.L. Jr. (Lawrence Berkeley Lab., CA, USA; Oak Ridge National Lab., TN, USA). *Radiochimica Acta;* 42: No. 2, 57-102(1987). Contract AC03-76SF00098;AC05-84OR21400.

Although the scientific literature now includes information on ten isotopes of element 104 and 6 isotopes of element 105 as well as on the chemical properties of these two elements, no official ruling has been made by any international body concerning their names nor the assignment of credit for discovery. A controversy has developed between research teams at the Joint Institute for Nuclear Research, an international laboratory at Dubna in the Soviet Union, and research teams at the Lawrence Berkeley Laboratory in the USA concerning the right to be recognized as the discoverers of elements 104 and 105. Both institutions have major facilities including nuclear particle accelerators which were used to synthesize isotopes of the new elements by bombardment of heavy element targets with heavy ions. This paper reviews the experimental studies carried out at both laboratories during the 1960-1977 period and makes a critical assessment of the physical and chemical evidence relating to the synthesis of element 104 and 105 and the claims based upon that evidence. Work done at several other institutions is cited when it is pertinent to the claims made by the research groups at Dubna or Berkeley. The authors then present their conclusions regarding the claims of the two laboratories to priority in the discovery of elements 104 and 105 and the right to name these elements.

19889 Comparison of measured and calculated neutron inelastic scattering cross sections for vibrational states from 680 to 1060 keV in ^{238}U. Egan, J.J.; Kegel, G.; Mittler, A.; Shao, J.Q.; Arthur, E.D. (Lowell Univ., MA, USA; Los Alamos National Lab., NM, USA). *Radiation Effects;* 95: No. 1-4, 203-206(1986). (CONF-850507—).

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

Measured and calculated data are presented on neutron inelastic scattering cross sections for vibrational states from 680 to 1060 keV in ^{238}U. Time-of-flight measurements were made at the University of Lowell, Massachusettes, (U.S.A.) using incident neutrons up to 2.2 MeV, and are compared with theoretical calculations carried out at the Los Alamos National Laboratory (U.S.A.). The paper was given at the International Conference on 'Nuclear data for basic and applied science', Santa Fe, (U.S.A.) 1985.

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 19818, 19865, 19866, 19875, 19878, 19883, 19886, 19886, 19889, 20644

19890 (DOE/ER/40154—4) Research in theoretical nuclear physics: Progress report, October 1, 1986-November 30, 1987. Liu, Keh-Fei. (Kentucky Univ., Lexington (USA)). 1987. Contract FG05-84ER40154. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004427/JAW.

The Euler-Langrange equation for the quantized skyrmion is derived. It modifies the static properties of the nucleon and it admits rotation and vibration coupling which should improve the baryon spectrum. The pi NN form factor from the Skyrme model is used to calculate the high energy PP scattering in the Chou-Yang model. Several projects on the lattice gauge Monte Carlo calculations are completed. The pion form factor is measured in both the relative charge distribution method and the symmetric source method. The vector and pseudoscalar meson decay constants are measured in the lattice QCD. The vacuum to glueball transition matrix elements are extracted to calculate the glueball branching ratios in J/psi radiative decays. The result helps identify theta (1720) as the tensor glueball. By combining data anti pn annihilation and gamma gamma reactions, we have pinned down that X/sub 0/ (1480) which decays to rho/sup 0/rho/sup 0/ is the mesonium we predicted. By postulating tensor meson dominance in the energy momentum tensor couplings, we obtain the vacuum to glueball transition amplitudes which agree with those extracted from the lattice to within a factor of 2. The branching ratio of theta (1720) in J/psi radiative decay is thus calculated which agrees with the experimental data. We have developed an extended Skyrme interaction which not only yields good Hartree-Fock ground states of spherical nuclei, but also predict electric and magnetic excitations which agree with experiments. Initial investigation on the particle-particle seems to show that the calculated /sup 18/O spectrum is desirable.

19891 (DOE/ER/40365—T1) Theoretical studies of intermediate-energy nuclear physics: Annual technical progress report for April 1, 1987 to March 31, 1988. Horowitz, C.J.; Macfarlane, M.H.; Serot, B.D. (Indiana Univ., Bloomington (USA). Dept. of Physics). 1988. Contract FG02-87ER40365. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005407/JAW.

In the period covered by this report (April 1, 1987 to March 31, 1988), work focused on five main areas: Relativistic Theories of Nuclear Structure and Saturation; Relativistic Descriptions of Proton-Nucleus Scattering; Multipole Sum Rules and Ground-State Correlations; Gamow-Teller Excitations in Nuclear Charge-Exchange Reactions; Relativistic Many-Body Theory at Finite Temperature and Density. Results and publications in these areas are summarized in this report. 32 refs., 1 fig.

19892 (IFUSP-P—632) Limiting total excitation energy of the nucleus and Levinson's theorem. Almeida, F.I.A. de; Chen, Y.T.; Hussein, M.S.; Donangelo, R.J. (Sao Paulo Univ., Brazil. Inst. de Fisica; Rio de Janeiro Univ., Brazil. Inst. de Fisica). (Sao Paulo Univ. (Brazil). Inst. de Fisica). 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701446/JAW.

The limiting total excitation energy of /sup 208/Pb is calculated using the nuclear partition function. A temperature dependence shell-model potential and an energy-dependent nucleon-nucleus optical potential are employed to generated the temperature-dependent bound single particle energies ϵ/sub K/ and the continuum level density rho (ϵ) respectively. Levinson's theorem is used to make the relevant change in rho (ϵ) due to the T- dependence of ϵ/sub K/(T). The calculated limiting total exitation energy is about one half of the one recently obtained by Deam and Mosel.

19893 (DOE/ER/40048—36-N7) Nuclear structure aspects of T invariance tests. Haxton, W.C. (Washington Univ., Seattle (USA). Inst. for Nuclear Theory). Apr 1987. Contract AC06-81ER40048. 6p. (CONF-8704152—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004167/JAW.

From Workshop on tests of time reversal invariance in neutron physics; Chapel Hill, NC, USA (17 Apr 1987).

Motivated by experiments on atomic electric dipole moments, the author carried out calculations to test T invariance for CP-violating NN interactions. 7 refs., 2 figs.

19894 (ENEA-RT-TIB—87-5) Chain of codes for the combinatorial calculation of level densities. Herman, M.; Raffo, G. (ENEA, Rome (Italy)). 1987. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701285/JAW.

A chain of codes has been developed to calculate state and level densities characterized by fixed exciton numbers. Shell-model orbitals are used as a basis for the calculations and the different configurations possible are generated by use of combinatorial calculations. The pairing interaction is accounted for in the frame of the BCS theory. The spin and parity distributions are provi.

19895 (IPNO-TH—86-64) Magnetic moments in present relativistic nuclear theories: a mean-field problem. Desplanques, B. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Jul 1986. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753197/JAW.

We show that the magnetic moments of LS closed shell nuclei plus or minus one nucleon derived from non-relativistic Hartree-Fock mean-fields are as bad as those obtained in relativistic approaches of nuclear structure. Deviations with respect to more complete results in both cases are ascribed to the mean-field approximation which neglects some degrees of freedom in the nucleus description. 18 refs.

19896 (IPNO-TH—86-69) Hyperspherical calculations for four-nucleon systems. Ballot, J.L. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire). Oct 1986. 11p. (CONF-8610196—9). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753196/JAW.

From European workshop on few body physics; Rome, Italy (7 Oct 1986).

We develop hyperspherical calculations on the bound states of four-nucleon systems and particularly the fundamental level and the first 0/sup +/ excited states. With neglect of the Coulomb effect, we analyze the convergence of the optimal subset expansion for the binding energies calculated for central or realistic potentials. 35 refs.

19897 (DOE/ER/04699—11) A search for the formation of the quark-gluon plasma by measurement of cross sections for direct photons and leptons: Annual progress report, April 1, 1987-March 31, 1988. Kirk, P.N. (Louisiana State Univ., Baton Rouge (USA). Intermediate Energy Nuclear Physics Group). 15 Dec 1987. Contract AS05-76ER04699. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004530/JAW.

The Intermediate Energy Nuclear Physics Group at LSU participated in three experiments during the past year. Two of these, the search for direct lepton pairs with the DLS and the study of e+ e- annihilation at KEK, are still on-line and logging data. The third, the search for subthreshold production of kaons and antiprotons was completed in the spring of 1987, and the apparatus was disassembled. We are pleased to report that during the months of April and May 1987, the three detectors built by our group - the drift chambers for the DLS, the multiwire proportional chambers for the kaon/LEBL beam line, and the ring veto counters for AMY at KEK - were operational and logging data all within the same general period of time. 29 figs.

19898 (BNL—40724) Prospects for meson spectroscopy studies with anti P's at the AGS. Dover, C.B. (Brookhaven National Lab., Upton, NY (USA)). 1987. Contract AC02-76CH00016. 19p. (CONF-8705253—1-Vugraphs). NTIS, PC A03. Order Number DE88005607/JAW.

From Workshop on antiproton physics at the AGS; Upton, NY, USA (29 May 1987).

This paper contains viewgraphs on studies of meson spectroscopy. Investigated are the pion inclusive spectrum of proton-an-

tiproton interactions, the spectrum of nucleon-antinucleon interactions, pion missing mass spectra and mechanisms for photon-photon interactions. (LSP)

19899 **(CONF-880232—2) A simplified unified Hauser-Feshbach/Pre-Equilibrium model for calculating double differential cross sections.** Fu, C.Y. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005442/JAW.

From Nuclear Energy Agency Nuclear Data Committee (NEANDC) specialists' meeting on preequilibrium nuclear reactions; Semmerling, Austria (10 Feb 1988).

A unified Hauser-Feshbach/Pre-Equilibrium model is extended and simplified. The extension involves the addition of correlations among states of different total quantum numbers (J and J') and the introduction of consistent level density formulas for the H-F and the P-E parts of the calculation. The simplification, aimed at reducing the computational cost, is achieved mainly by keeping only the off-diagonal terms that involve strongly correlated 2p-1h states. A correlation coefficient is introduced to fit the experimental data. The model has been incorporated into the multistep H-F model code TNG. Calculated double differential (n,xn) cross sections at 14 and 25.7 MeV for iron, niobium, and bismuth are in good agreement with experiments. In use at ORNL and JAERI, the TNG code in various stages of development has been applied with success to the evaluation of double differential (n,xn) cross sections from 1 to 20 MeV for the dominant isotopes of chromium, manganese, iron, nickel, copper, and lead. 11 refs., 2 figs.

19900 **(DOE/ER/40322—010) Elastic scattering of protons by ^{16}O, ^{40}Ca and ^{208}Pb at 200, 500 and 800 MeV: 1, Relativistic and nonrelativistic analyses based on the impulse approximation.** Ottenstein, N.; Wallace, S.J.; Tjon, J.A. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy; Rijksuniversiteit Utrecht (Netherlands). Inst. voor Theoretische Fysica). Nov 1987. Contract FG05-87ER40322. 66p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005764/JAW.

Systematics of Dirac impulse approximation predictions for cross sections and spin observables in elastic proton scattering by ^{16}O, ^{40}Ca and ^{208}Pb at energies of 200, 500 and 800 MeV are presented. The analysis is based on an optical potential constructed from complete sets of Lorentz invariant NN amplitudes. The NN amplitudes are determined from a relativistic meson exchange model of the nuclear force. Comparisons are made with the original form of the Dirac impulse approximation, which is based on five Fermi terms to represent the NN interaction, and with the Schroedinger form of the impulse approximation. For the Dirac analyses, there is implicit coupling to virtual nucleon-antinucleon states. In order to illustrate these contributions, the Dirac equation is recast in the form of the Schroedinger equation and the resulting Schroedinger potentials are separated into "no-pair" and virtual-pair parts. The resulting virtual-pair part of the central potential is typically 25 MeV at the center of the nucleus for 200 MeV to 800 MeV protons. A reasonable description of the experimental data is obtained over a broad energy range and over a wide variation of nuclear size when the analysis is based on complete sets of Lorentz-invariant amplitudes. 34 refs., 23 figs.

19901 **(DOE/ER/40322—014) Elastic scattering of protons by ^{16}O, ^{40}Ca and ^{208}Pb at 200, 500 and 800 MeV: 2, Effects of vacuum polarization and Pauli blocking corrections.** Ottenstein, N.; Wallace, S.J.; Tjon, J.A. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy; Rijksuniversiteit Utrecht (Netherlands). Inst. voor Theoretische Fysica). Nov 1987. Contract FG05-87ER40322. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005763/JAW.

Dirac impulse approximation predictions for cross sections and spin observables in elastic proton scattering by ^{40}Ca and ^{208}Pb at energies of 200, 500 and 800 MeV are presented. The analysis is based on complete sets of Lorentz invariant NN amplitudes determined from a meson exchange model of the nuclear force. Effects of relativistic nuclear densities are explored including estimates of the vacuum polarization corrections based on quantum hadrodynamics. Effects of Pauli blocking are considered using the approximations of Murdock and Horowitz. A good description of the experimental data is obtained over a broad energy range and over a wide variation of nuclear size based on the generalized impulse approximation. Vacuum polarization corrections are found to enhance the agreement between theory and experiment. 18 refs., 8 figs.

19902 **(EFI—857(8)-86) Dependence of inclusive electroproduction cross sections of He, LI, Be,B fragments on the charge, emission angle, the energy of electrons, the mass number of the target nucleus and their analysis.** Ajvazyan, G.M.; Badalyan, G.V.; Beglaryan, D.M.; Markaryan, G.E.; Pogosov, V.S. (Erevanskij Fizicheskij Inst. (USSR)). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703146/JAW.

The dependences of inclusive electroproduction cross sections of He, Li, Be, B fragments on the charge, the angle of emission, the energy of electrons, the mass number of the target nucleus are analyzed. Comparison with analogous dependences obtained on proton beams and those obtained from the calculations by snowball theoretical model is carried out.

19903 **(FEI—1754) Numerical methods of calculation of binary nuclear reactions with polarized fragments. Basic equations.** Titarenko, N.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703162/JAW.

On the basis of irreducible spherical spin-tensor formalism the modern approach to the description of binary nuclear reactions with an arbitrary spin structure of fragments is presented. The basic properties of irreducible tensors are discussed, special attention is paid to multipole series expansion of operators and functions. Properties of spin density matrix and its decomposition by spin-tensor operators are presented. In the framework of model-independent approach the expressions to calculate polarization characteristics of binary nuclear reactions are obtained. Restrictions to which they obey are considered. 8 references.

19904 **(FEI—1797) Calculation of resonance self-shielding effects and neutron scattering in a sample at measurements of microscopic cross sections of radiative neutron capture.** Van'kov, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 17p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703167/JAW.

The analytical method for correction calculation of self-shielding and neutron scattering in a sample with respect to the resonance structure of neutron cross sections in the range of unresolved resonances is developed. Numerical results are obtained for U-238 as reactor requirements of high accuracy (2%) of radiative capture cross sections for this nuclide causes the necessity of thoroughly account of all methodical factors affecting the estimation of experimental results. One of such important factors is the considered scattering in sample correction. The results obtained are compared with the results of the calculational method used before, as well as with the results of the Monte Carlo method. 11 references, 1 figure.

19905 **(FEI—1801) CCA-84 program: calculation of inelastic scattering cross sections of particles on nuclei by the coupled channel method. Basic equations.** Titarenko, N.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703168/JAW.

Basic formulae of the coupled channel method (CCM) for computer - aided design of differential cross-sections and different polarization characteristics observed in the processes of inelastic scattering of particles with an arbitrary charge and spin on nuclei are given. The algorithm of the CCA-84 program is based on the expansion of the fragment interaction potential over irreducible tensor operators. It permits within the CCM frame to consider dif-

ferent aspects of inelastic scattering of particles on nuclei having both a collective spectrum of excited states and a single-particle one, using just phenomenological nucleon-nucleon potentials. 11 references.

19906 **(FEI—1831) On some features of realization of a new version of the strong coupled channel method.** Tertychnyj, G.Ya. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1987. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701287/JAW.

Numerical realization of a new version of strong coupled channel method (SCCM) is suggested for studying isobar-analogous resonance (IAR) in compound nucleus. Inelastic scattering of /sup 207/Pb(p, p') with IAR excitation in compound /sup 208/Bi nucleus is considered as a concrete example of SCCM usage. Analysis of the results obtained has revealed IAR-0/sup +/ main specific feature, namely: six open in energy channels play a dominating role in resonance shaping. Effect of closed channels on resonance transition density and cross section of inelastically scattered protons within the limits of IAR is insignificant. SCCM practical use experience, realized by BESM-6 computer, has shown its high efficiency. Estimations of main time T of calculation on energy in each point demonstrate that 0.5 s/channel $<T<$ 3 s/channel. 8 refs.; 5 figs.

19907 **(GANIL-P—87-01) Decay of a hot zone in finite nuclei.** De, J.N.; Gregoire, C. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1987. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753190/JAW.

Assuming that a hot zone is formed in nuclear collisions, we study its decay in the surrounding colder nuclear matter. Thermal equilibration resulting from energy transport is analyzed in terms of a classical model and within the Vlasov-Uehling-Uhlenbeck self-consistent approach. Convection is found to be the dominant energy propagation mode. Thermal equilibration time is found to be of the order of the damping of isoscalar quadrupole vibration, i.e. a few 10/sup -21/ sec. This feature may not be fully consistent with recent available experimental data and casts doubt on the possibility of formation of a sharply localised thermally equilibrated hot zone as a likely intermediate state for excitation in finite nuclei in intermediate energy collisions. 16 refs.

19908 **(GANIL-P—87-02) Spin dispersion and alignment in deep inelastic collisions.** Krishan, K.; Samaddar, S.K.; De, J.N. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). 1987. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE87753191/JAW.

The spins accumulated by the reacting heavy nuclei, their variances and their alignments with respect to the reaction normal in deep inelastic collisions have been calculated in the framework of stochastic exchange of single nucleons on a potential energy surface. The effects due to temperature and shell gap in the single particle spectra on the spin observables have also been studied. It is found that though the presence of the gap reduces the spin gain, its effect on alignment is small. Temperature is found to have an insignificant role on all the spin observables studied. The relative spin orientations of the reacting partners are found to be strongly sensitive to the presence of the dynamical barrier between them. 22 refs.

19909 **(IAE—4186/2) Program package for calculation of cross sections of neutron scattering on deformed nuclei by the coupled-channel method.** Kloss, Yu.Yu. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703184/JAW.

Program package and numerical solution of the problem for a system of coupled equations used in optical model to solve a problem on low and mean energy neutron scattering on deformed nuclei, is considered. With these programs different scattering cross sections depending on the incident neutron energy on even-even and even-odd nuclei were obtained. The programm permits to obtain different scattering cross sections (elastic, inelastic), excitation cross sections of the first three energy levels of rotational band depending on the energy, angular distributions and neutron polarizations including excited channels. In the program there is possibility for accounting even-even nuclei octupole deformation. 9 references, 10 figures.

19910 **(IAE—4187/2) Cross sections of neutron scattering on deformed nuclei with proton excess.** Kloss, Yu.Yu.; Nemirovskij, P.Eh. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703185/JAW.

Neutron scattering (at the energy of 0.01-8 MeV) on deformed even-odd nuclei with proton excess (^{159}Tb, ^{231}Pa, ^{237}Np, ^{241}Am) is considered. The method of coupled channels is put in the basis of the study. Dependences of total and inelastic cross sections of neutron scattering, as well as cross sections of excited levels via compound-nucleus, are obtained. Direct processes of the main rotational band level excitation are investigated. The calculation for ^{231}Pa nucleus with violated sequence of the level spin values is given, the dependence of cross section behaviour on the energy for different nuclei is confirmed. 9 references, 2 figures.

19911 **(ITEF—114(1986)) Disintegration of photoemulsion nuclei in small angle inelastic scattering of 32 GeV muons. Collective effects.** Rabin, N.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 11p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701372/JAW.

The aim of the paper is to find out if there are collective processes in events of inelastic muon scattering and how much they are essential. Arguments for production in muon events of moving excited cluster with the average number of nucleons n-bar$\sim$8, temperature T/sub 0/$\approx$55 MeV and velocity $\beta\approx$ 0.1 are given. This cluster is shown to be a main source of fast protons in events. 11 refs.; 4 figs.

19912 **(JINR-R—2-86-182) On criteria of the choice of cumulative meson production scheme. Internal self-consistency of the scheme. Comparative analysis of A dependences.** Golubyatnikova, E.S.; Shmonin, V.L.; Kalinkin, B.N. (AN Kazakhskoj SSR, Alma-Ata. Inst. Fiziki Vysokikh Ehnergij; Joint Inst. for Nuclear Research, Dubna, USSR. Lab. of Theoretical Physics). (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701501/JAW.

Submitted to the journal Acta Phys. Pol. .

Cumulative meson production is one of the most experimentally studied cumulative effects. Here basic criteria are discussed, which are to be applied to theoretical schemes of the interpretation of this effect. Examples of criteria are given which control the internal consistency of a concrete scheme from the general physics point of view. The established experimentally A dependencies of the yields of cumulative mesons in different processes prove that their source is localized beyond the nucleus. The formulated on this basis criterion permits to reject a series of models of the process considered. 19 refs.; 7 figs.

19913 **(UCID—21309) Cross sections and differential spectra for reactions of 2 to 20 MeV neutrons on /sup nat/ Fe.** Blann, M.; Komoto, T.T. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 33p. NTIS, PC A03. Order Number DE88006248/JAW.

This report summarizes product yields, secondary n,p and α spectra, and γ-ray spectra calculated for incident neutrons of 2 to 20 MeV on /sup nat/Fe targets. Results are all from the code ALICE, using the version ALISO which does weighting of results for targets which are a mix of isotopes. Where natural isotopic targets are involved, yields and n,p,α spectra will be reported weighted over isotopic yields. Gamma-ray spectra, however, will be reported for the most abundant isotope. We present product yields

versus incident neutron energy, n,p,α spectra versus incident neutron energy, and calculated γ-ray spectra.

19914 **(UCID—21312) Cross sections and differential spectra for reactions of 2-20 MeV neutrons of ^{27}Al.** Blann, M.; Komoto, T.T. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005881/JAW.

This report summarizes product yields, secondary n,p and α spectra, and γ-ray spectra calculated for incident neutrons of 2-20 MeV on ^{27}Al targets. Results are all from the code ALICE, using the version ALISO which does weighting of results for targets which are a mix of isotopes. Where natural isotopic targets are involved, yields and n,p,α spectra will be reported weighted over isotopic yields. Gamma-ray spectra, however, will be reported for the most abundant isotope.

19915 **(UCRL—97948) Recent progress and current status of preequilibrium reaction theories and computer code ALICE.** Blann, M. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 29p. (CONF-880342—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005218/JAW.

From International Centre for Physics workshop on applied nuclear theory and nuclear model calculations for nuclear technology application; Trieste, Italy (5 Mar 1988).

A review of the hybrid/geometry dependent hybrid models is given as implemented in the computer code ALICE. Discussion is given of evaluation of the relevant parameters. Exercises are given for executing different types of precompound plus compound decay processes in the code ALICE. Relevant supplementary literature is appended vis-a-vis parameter evaluation, calculations involving fission de-excitation. 23 refs., 3 figs.

19916 **Reaction cross-section calculations using new experimental and theoretical level structure data for deformed nuclei.** Hoff, R.W.; Gardner, D.G.; Gardner, M.A. (Lawrence Livermore National Lab., CA, USA). *Radiation Effects;* **95**: No. 1-4, 119-123(1986). (CONF-850507—). Contract W-7405-ENG-48.

From International conference on nuclear data for basic and applied science; Santa Fe, NM, USA (13 May 1985).

A technique for modeling level structures of odd-odd nuclei has been used to construct sets of discrete states with energies in the range 0 -1.5 MeV for several nuclei in the rare-earth and actinide regions. The accuracy of the modeling technique was determined by comparison with experimental data. Examination was made of what effect the use of these new, more complete sets of discrete states has on the calculation of level densities, total reaction cross sections, and isomer ratios.

19917 **(CEA-N—2522) Study of the (anti) neutrino background expected in the nucleon lifetime Frejus experiment. Data used: (anti) neutrino events of the spark chamber experiment in the CERN PS (Aachen-Padova collaboration).** Kolton, W. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). Apr 1987. 88p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE87753179/JAW.

The goal of the Frejus experiment is the measurement of the nucleon lifetime, using a 900 ton fine grain iron calorimeter. The background due to the interaction of atmospheric (anti) neutrinos is studied with data from a spark chamber experiment in the CERN PS low energy neutrino beam (Aachen-Padova collaboration). The analysis of the data yields a preliminary estimate of the (anti) neutrino background which is expected for nucleon decays into a charged lepton. An important feature of the (anti) neutrino background is that one half of the background come from events where a secondary re-interaction vertex is taken as the main vertex.

19918 **(JINR-E—4-86-577) Influence of pairing correlations on the probability and dynamics of tunneling through the barrier in fission and fusion of complex nuclei.** Lazarev, Yu.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1986. 24p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701500/JAW.

Submitted to the journal Phys. Scr. .

An analytically solvable model is used to study the potential barrier penetrability in the case when the gap parameter Δ is treated as a dynamical variable governed by the least action principle. It is found that, as compared to the standard (BCS) approach, the dynamical treatment of pairing results in a considerably weakened dependence of the fission barrier penetrability on the intensity of pairing correlations in the initial state (Δ/sub 0/), on the barrier height, and on the energy of the initial state. On this basis, a more adequate explanation is proposed for typical order-of-magnitude values of the empirical hidrance factors for groun-state spontaneous fission of odd nuclei. It is also shown that a large enhancement of superfluidity in tunneling - the inherent effect of the dynamical treatment of pairing - strongly facilitates deeply subbarier fusion of complex nuclei. Finally, an analysis is given for the probability of spontaneous fission from K-isomeric quasiparticle (q-p) states in even-even heavy nuclei. The relative change of the partial spontaneous fission half-life in going from the ground-state to a high-spin q-p isomeric state, T*/sub sf//T/sub sf/, is found to be strongly dependent on whether or not there takes place the dynamically induced enhancement of superfluidity in tunneling. Measurements of T*/sub sf//T/sub sf/ provide thus a unique possibility of verifying theoretical predictions about the strong, inverse-square Δ dependence of the effective inertia associated with large-scale subbarrier rearrangements of nuclei. 49 refs.; 7 figs.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 18213, 18809, 19564, 19584, 19934, 19946, 20224, 20722, 20723, 20725, 20727, 20728

19919 **(DEMO—87/1G) Radioactive deposition on surfaces and shielding factors for buildings. A preliminary assessment for the Greek territory.** Catsaros, N.; Vassiliou, A. (National Research Centre for the Physical Sciences Democritos, Athens (Greece)). Jan 1987. 46p. (In Greek). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701262/JAW.

This report analyses the problem of the activity deposited on different surfaces. The theoretical background for the calculation of shielding factors for building and houses is exposed. Some estimations are made for the shielding factors of typical Greek buildings and houses based on a modified Fortran-77 version of the computer code DEPSHIELD named SHIELD-F. A preliminary assessment of the average shielding factor of the Attica basin is made.

19920 **(AD-A—185930/5/XAB) Application of vector diffraction to the scalar anomalous diffraction approximation of van de hulst. Master's thesis.** Mahood, R.W. (Air Force Inst. of Tech., Wright-Patterson AFB, OH (USA)). May 1987. 101p. (AFIT/CI/NR—87-103T). NTIS, PC A06/MF A01.

The extinction, absorption, and differential scattering cross sections of particles are, in general, functions of the polarization state of the incident radiation; however, this dependency cannot be predicted by van de Hulst's anomalous diffraction approximation because it is a scalar theory. To overcome this deficiency, the Kirchoff and Kirchoff-Kottler vector-diffraction formulations were used to modify anomalous diffraction in the hope that polarization effects could then be accounted for. Unfortunately, even with the modification, no polarization dependence was predicted for any of the cross sections. In actuality, the differential scattering cross section did show a second-order polarization dependence, but it was negligible within the limits of the approximation. In addition to the above work, a comprehensive, critical literature review of all previous uses of anomalous diffraction was conducted. In this review, the apparent differences between the Cross and Latimer (1970) and Stephens (1984) anomalous diffraction solutions for the extinction and absorption efficiencies of an infinite cylinder were reconciled.

19921 (FEI—1709) Relation between estimations on collisions and range for linear functionals of radiation transport theory. Blyskavka, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703152/JAW.

Rule of construction of estimations by path out of nonshifted estimation by collisions for linear functionals of collision density, when simulating equations of transfer in a finite area with leakage inhibition, has been formulated and substantiated. 2 references.

19922 (FEI—1752) Interpolation of tabulated total cross section of photon interactions, photoeffect cross section and kerma-factor. Bondarenko, I.M.; Dubinin, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703160/JAW.

Rapid and exact interpolation method is proposed for determining the total cross section of photon interaction, photoeffect and kerma-factor cross section. The method is based on the cross section representation as a photon energy function in the form of a polynomial. Total cross section and kerma-factor are interpolated within 1-10 keV; 0.01-0.15 MeV and 0.15-20 MeV photon energy ranges. The photoeffect cross section is interpolated within 1-10 keV and 0.01-20 MeV photon energy ranges. Interpolation coefficients are calculated for 30 elements by the least square fit on the basis of the tabulated data. 5 tables.

19923 (FEI—1753) Interpolation of the tabulated cross sections of photon scattering and pair production cross sections. Bondarenko, I.M.; Dubinin, A.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703161/JAW.

Accurate interpolation technique is used to determine the cross sections of coherent and incoherent photon scattering and pair production cross section. These cross sections are represented as a photon energy function in the form of a polynomial. Coherent and incoherent scattering cross sections are interpolated within 1-10 keV and 0.01-20 MeV photon energy ranges. Pair production cross section is interpolated within 1.022-3 MeV and 2-20 MeV photon energy ranges. Interpolation coefficients are calculated for 46 elements by the least square fit on the basis of the tabular data. The maximal interpolation error for some elements achieves at certain points 1.1%, but in most cases it does not exceed 0.3%. 4 tables.

19924 (INIS-mf—11087) Frequency Analysis of Acoustic Emission - Application to machining and welding. Snoussi, A. (Haut Commissariat a la Recherche, Algiers (Algeria). Centre d'Etudes Nucleaires et Solaires). Jan 1987. 115p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number TI88701478/JAW.

Ultrasonic acoustic waves have been seized and exploited within a bandwidth ranging from 30 kHz to 55 kHz for non-destructive control when boring 3 kinds of steel with a digitaly programmed drill. In addition, these waves have been considered in soldering two steels and one aluminium using T.I.G. process. Spectrum analysis of acoustic emissions produced during the drill is closely related to the extraction of turnings from the metal. Because of the wick's progressive wearing out, the spectrum tends to be close to the machine's own noise spectrum. Meanwhile in the soldering operation of test-tubes of 2 mm thickness, the frequency analysis shows a particular frequency called "signature" corresponding to the flow of protection gas. Other frequencies associated to some internal defects in the soldering process as a delay in the fissure and a lack in the fusion have been detected.

19925 (LA-UR—88-229) Boltzmann-Fokker-Planck calculations using standard discrete-ordinates codes. Morel, J.E. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 16p. (CONF-8702113—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005393/JAW.

From Computational methods in high temperature physics; Los Alamos, NM, USA (2 Feb 1987).

The Boltzmann-Fokker-Planck (BFP) equation can be used to describe both neutral and charged-particle transport. Over the past several years, the author and several collaborators have developed methods for representing Fokker-Planck operators with standard multigroup-Legendre cross-section data. When these data are input to a standard S/sub n/ code such as ONETRAN, the code actually solves the Boltzmann-Fokker-Planck equation rather than the Boltzmann equation. This is achieved wihout any modification to the S/sub n/ codes. Because BFP calculations can be more demanding from a numerical viewpoint than standard neutronics calculations, we have found it useful to implement new quadrature methods ad convergence acceleration methods in the standard discrete-ordinates code, ONETRAN. We discuss our BFP cross-section representation techniques, our improved quadrature and acceleration techniques, and present results from BFP coupled electron-photon transport calculations performed with ONETRAN. 19 refs., 7 figs.

19926 (PB—88-156724/XAB) Electron and photon transport in multi-layer media: notes on the Monte Carlo code ZTRAN. Seltzer, S.M.; Berger, M.J. (National Bureau of Standards, Washington, DC (USA). Center for Radiation Research). Sep 1984. 50p. (NBSIR—84/2931). NTIS, PC A03/MF A01.

The report provides a brief description and running instructions for the one-dimensional Monte Carlo code ZTRAN. The program is used to calculate the transport of electrons and photons in heterogeneous multi-layer media.

19927 Calculations of physical and chemical reactions produced in liquid water by Auger cascades. Wright, H.A.; Hamm, R.N.; Turner, J.E.; Howell, R.W.; Sastry, K.S.R.; Rao, D.V.; Haydock, C. (Oak Ridge National Lab., Oak Ridge, TN 37831). pp 48 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—). Contract AC05-84OR21400.

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

Calculations have been made of physical and chemical events produced in liquid water by Pt-193m Auger cascade emitters. The Pt-193m radionuclide decays by the emission of three separate bursts of electrons, each complete within 10/sup -14/ s, and separated by times of the order of nanoseconds. The authors performed Monte Carlo calculations of the energies of electrons produced in each burst. They then performed computations of the transport of the electrons through liquid water. The energy deposited and the chemical species produced in small spheres surrounding the site of the emitter have been tabulated. They also calculated the time decay of the chemical species. Implications for effects of such Auger cascades in biological systems are discussed.

19928 Modification of electron-transport code, OREC, for use in beta dosimetry. Turner, J.E.; Hamm, R.N.; Martz, D.E.; Darois, E.L.; Souleyrette, M.L.; Rhea, T.A. (Oak Ridge National Lab., Oak Ridge, TN 37831). pp 49 of Thirty-fifth annual meeting of the Radiation Research Society (Abstracts). Philadelphia, PA; Radiation Research Society (1987). (CONF-870221—). Contract AC05-84OR21400.

From 35. annual meeting of the Radiation Research Society; Atlanta, GA, USA (22 Feb 1987).

A modified version of the Monte Carlo computer code, OREC, for the complete transport and energy degradation of primary and secondary electrons in liquid water is being developed for its potential application to beta-ray dosimetry. The principal adaptation of the original transport code from water to plastic was accomplished by uniform scaling of the inelastic inverse means free paths. The altered code gives reasonably good agreement with beta spectral data and depth-dose curves measured in tissue-equivalent plastics with several calibrated plaque and point sources. The Monte Carlo code can be used to calculate directly beta-particle doses at a tissue depth of 70 μm, the quantity needed for personnel monitoring of skin exposure to radiation.

19929 **Method for synthetically accelerating discontinuous finite element transport calculations.** Adams, M.L.; Martin, W.R. (Lawrence Livermore National Lab., CA). *Transactions of the American Nuclear Society;* **54**: 159-160(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

In the past few years several synthetic acceleration methods have been proposed for transport calculations. Each of these, at this time, has a drawback that significantly limits its utility: the nonlinear methods, which make use of a relatively easy-to-solve diffusion equation, can be unstable for large meshes; the linear methods, which are stable, make use of a set of P1 or other equations that may be difficult, in general, to solve efficiently. The authors present here a linear method that makes use of a diffusion equation, yet unconditionally retains stability and rapid convergence. In its present stage, however, the method is applicable only to discontinuous finite element method (FEM) spatial discretizations of the transport equation, such as the linear discontinuous method.

19930 **Nodal integral method for the neutron diffusion equation in cylindrical geometry.** Azmy, Y.Y. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **54**: 183-184(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

The nodal methodology is based on retaining a higher a higher degree of analyticity in the process of deriving the discrete-variable equations compared to conventional numerical methods. As a result, extensive numerical testing of nodal methods developed for a wide variety of partial differential equations and comparison of the results to conventional methods have established the superior accuracy of nodal methods on coarse meshes. Moreover, these tests have shown that nodal methods are more computationally efficient than finite difference and finite-element methods in the sense that they require shorter CPU times to achieve comparable accuracy in the solutions. However, nodal formalisms and the final discrete-variable equations they produce are, in general, more complicated than their conventional counterparts. This, together with anticipated difficulties in applying the transverse-averaging procedure in curvilinear coordinates, has limited the applications of nodal methods, so far, to Cartesian geometry, and with additional approximations to hexagonal geometry. In this paper the authors report recent progress in deriving and numerically implementing a nodal integral method (NIM) for solving the neutron diffusion equation in cylindrical r-z geometry. Also, presented are comparisons of numerical solutions to two test problems with those obtained by the Exterminator-2 code, which indicate the superior accuracy of the nodal integral method solutions on much coarser meshes.

19931 **Bilinear nodal transport method in weighted diamond difference form.** Azmy, Y.Y. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **54**: 187-189(1987). (CONF-870601—).

From Annual meeting of the American Nuclear Society; Dallas, TX, USA (7 Jun 1987).

Nodal methods have been developed and implemented for the numerical solution of the discrete ordinates neutron transport equation. Numerical testing of these methods and comparison of their results to those obtained by conventional methods have established the high accuracy of nodal methods. Furthermore, it has been suggested that the linear-linear approximation is the most computationally efficient, practical nodal approximation. Indeed, this claim has been substantiated by comparing the accuracy in the solution, and the CPU time required to achieve convergence to that solution by several nodal approximations, as well as the diamond difference scheme. Two types of linear-linear nodal methods have been developed in the literature: analytic linear-linear (NLL) methods, in which the transverse-leakage terms are derived analytically, and approximate linear-linear (PLL) methods, in which these terms are approximated. In spite of their higher accuracy, NLL methods result in very complicated discrete-variable equations that exhibit a high degree of coupling, thus requiring special solution algorithms. On the other hand, the sacrificed accuracy in PLL methods is compensated for by the simple discrete-variable equations and diamond-difference-like solution algorithm. In this paper the authors outline the development of an NLL nodal method, the bilinear method, which can be written in a weighted diamond difference form with one spatial weight per dimension that is analytically derived rather than preassigned in an ad hoc fashion.

6550 Medical Physics

REFER ALSO TO CITATION(S) 17841, 18247, 18257, 19031, 19277, 19278, 19564, 19583, 19928

19932 **(INIS-GB—117) Statement from the 1987 Como meeting of the International Commission on Radiological Protection.** (International Commission on Radiological Protection, Sutton (UK)). 1987. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752355/JAW.

Supplement to Radiol. Prot. Bull., no.86.

A summary of the 1987 meeting of the ICRP is given. Topics covered include the work on cancer risk assessment, in particular the atomic bomb survivor studies, the risk of mental retardation by exposure of children to radiation in utero, health risks from radon in spas and reference terms for estimates of radiation dose for X-ray mammography. Forthcoming publications are mentioned.

19933 **(NRPB-GS—9) Interim guidance on the implications of recent revisions of risk estimates and the ICRP 1987 Como statement.** Clarke, R.H. (National Radiological Protection Board, Chilton (UK)). Nov 1987. 8p. H.M. Stationery Office, London, price Pound 3.00.

The ICRP statement indicates that a preliminary re-assessment of the Horoshima and Nagasaki survivors has raised the fatal cancer risk estimate for the exposed population by a total factor of the order of 2. This information, in the view of ICRP, is not considered sufficient to warrant a change in dose limits for occupational exposure. In particular, it is recommended that individual workers doses should be controlled so as not to exceed an average of 15 mSv effective dose equivalent per year. For individual members of the public, it is recommended that the effective dose equivalent should not exceed 0.5 mSv per year from effluent discharges from a single site. The Board expects that because all exposures will be as low as reasonably achievable, most resulting doses will be well below these figures.

19934 **(BARC—1359) Computational study of yields and spectra of a possible low energy (keV) neutron calibration source.** Nagarajan, P.S.; Sundaram, V.K. (Bhabha Atomic Research Centre, Bombay (India)). 1987. 75p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88701243/JAW.

The version of MORSE-CG and ANISN-W codes available with authors are validated and seem to be reliable. This conclusion is arrived at by running both the codes for the same physical problem, namely, that of obtaining neutron spectra and perceived yields at various radial distances from the centre of a spherical low energy neutron source of the (gamma,n) type. The same energy group structure and cross-section set are employed by both the codes. A few parameters of the design of such a low energy calibration source have been studied. The incidental results are discussed in detail. 30 figures, 32 tables, 11 refs.

19935 **(INDC(NDS)—196/GE) Gamma-ray standards for detector calibration. Summary report of a research coordination meeting held in Rome, Italy, 11-13 June 1987.** Christmas, P.; Nichols, A.L.; Lorenz, A. (eds.). (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Sep 1987. 14p. (CONF-8706271—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701450/JAW.

From Research coordination meeting on the measurement and evaluation of gamma-ray standards for detector calibration; Rome, Italy (11 Jun 1987).

The first official meeting of the IAEA Coordinated Research Programme on the Measurement and Evaluation of X- and Gamma-ray Standards for Detector Calibration was held in Rome from 11 to 13 June 1987. Work undertaken by the CRP members was reviewed in detail: specific problems in the evaluations were

identified and actions placed on the participants to resolve these issues. (author). 3 tabs.

19936 (IRD-CNEN-NT—012/87) Abreu system - A dosimetric system to evaluate basic parameters of photofluorographic X-ray machine. Feital, J.C. (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro (Brazil)). 1987. 28p. (In Portuguese). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701486/JAW.

In Brazil, photofluorographic X-ray machines are used for cuberculosis mass screening throughout the country. The exact number of these X-ray equipment is unknown but it is estimated to be around 1000 operating units. Twelve million miniature chest radiographs are taken per year. In order to make local inspections speedier and also aiming at its postal use, a system has been developed wich evaluates the entrace exposure of the patient, the X-ray beam half-value layer (leading to the evaluation of the tube's total filtration) and the beam's field size. It consists of a piece of cardboard where filters, TLDs and X-ray films are inserted. So far the system has been tested in 53 X-ray machines in Rio de Janeiro. The results show that it can be used in a national survey program.

6560 Condensed Matter Physics

REFER ALSO TO CITATION(S) 17973, 17975, 18553, 18637, 18699, 18718, 18740

19937 (AD-A—185987/5/XAB) Solid-state research. Quarterly technical report, 1 November 1986-31 January 1987. McWhorter, A.L. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 15 Feb 1987. 109p. NTIS, PC A06/MF A01.

Contents include: high-spectral-purity c-w and pulsed output from an ensemble of discrete diode lasers; ohmic heating in p-substrate buried heterostructure lasers - an analytical solution; proton irradiation and annealing of Fe-doped semi-insulating InP 16-gb/s large-signal digital modulation of diode lasers; studies of transient effects in Ti:A10 laser tuning; acousto optic modulator as a unidirectional device in a ring laser; model-locked Ti:A10 laser injection-locking a 1.32-micrometer Nd:YAG laser with a diode laser; generation of second harmonic of Nd:YAG laser radiation; new system for zone-melting recrystallizations of SOI films; diffusion model for estimating interface widths in heterostructures grown in a vertical OMVPE reactor; laser direct-written tungsten microstrip lines for GaAs monolithic microwave integrated-circuit trimming; small-signal gain performance of the permeable-base transistor at ehf; pbt sample-and-hold circuits; fabrication of submicrometer-size structures in Si using Sf/reactive ion etching; incremental writing in MNOS capacitors; laser photochemical processing of Cr-CrO films for amplitude compensation of surface acoustic-wave devices; and low-phase-noise oscillators stabilized by bulk-acoustic-wave holographic grating resonators.

19938 (CONF-8706103—5) The coordination cluster theory for metallic solutions. Blander, M.; Saboungi, M.L. (Argonne National Lab., IL (USA)). Dec 1987. Contract W-31109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005934/JAW.

From NATO advanced study institute on alloy phase stability; Crete, Greece (14 Jun 1987).

The coordination cluster theory for the thermodynamic properties of a dilute solute in a binary or higher order solvent. Although the CCT has been applied to liquids, it can be modified for solids. The theory permits one to describe the thermodynamic properties of a solute in a binary solvent in terms of the solute properties in the pure solvent components, the properties of the binary mixture and one unknown parameter. In principle, the properties of solutes in multicomponent solvents can be calculated from those in the subsidiary binary solvents. Modern quantum mechanical methods for the calculation of the energetics of metal solutions could be used to place the theory on a firm fundamental basis by testing the approximations in the theory and determining the unknown parameters. 9 refs., 3 figs.

19939 (CONF-8708158—Summ.) Whither many-body theory? A summary of the Oulu Conference. Clark, J.W. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003095/JAW.

From 5. international conference on the recent progress in the many-body theories; Oulu, Finland (3 Aug 1987).

There are basically two types of contributions to many-body theory, those focusing on the development of new methods and techniques and those which seek to understand many-body phenomena in particular systems. The work presented at this conference is weighted far more heavily toward applications and toward the explication of mechanisms underlying observed phenomena than was the case at previous conferences in this series. In the topical composition of this conference we observe also a shift away from the "hard-core" systems (the helium liquids and solids, nuclei, nuclear matter) which have dominated the attention of microscopic theorists for three decades. The new emphasis is on "not-so-strongly-interacting" systems, primarily electronic systems in various guises of current experimental relevance. In particular, the impact of the new discoveries of high-temperature superconductors on the thrust of many-body theories is already apparent in many of the papers at this conference.

19940 (IA—1427, pp 8) Effective equation of motion for gas-solid interactions. Zeiri, Y. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19941 (IA—1427, pp 70-71) Disclinations and the occurence of local magnetism in metallic systems. Watson, R.E.; Bennet, L.H.; Melamud, M. (Brookhaven National Lab., Upton, NY, USA; National Bureau of Standards, Gaithersburg, MD, USA; Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19942 (IA—1427, pp 79-80) Structural and magnetic properties of NpMn/sub 2/Ge/sub 2/ intermetallics. Schaefer, W.; Will, G.; Litterst, F.J.; Potzel, W.; Asch, L.; Kalvius, G.M.; Fredo, S.; Gal, J. (Bonn Univ., Germany, F.R. Mineralogisch-Petrologisches Inst. und Museum; Technische Univ. Muenchen, Garching, Germany, F.R. Fakultaet fuer Physik; Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19943 (IA—1427, pp 80-82) Investigation of the low-temperature structure of third stage HNO/sub 3/-Graphite intercalation compound. Shaked, H.; Pinto, H.; Melamud, M. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19944 (IA—1427, pp 83) Compton-profile anisotropies in graphite and hexagonal boron nitride. Tyk, R.; Felsteiner, J.; Gertner, I.; Moreh, R. (Technion-Israel Inst. of Tech., Haifa; Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19945 (IA—1427, pp 76-78) Stability of magnetic order in neptunium heavy electron intermetallics. Gal, J.; Fredo, S.; Tapuchi, S.; Litterst, F.J.; Potzel, W.; Asch, L.; Kalvius, G.M.; Jove, J.; Coussonn, A.; Thevenin, A. (Israel Atomic Energy Commission, Tel Aviv; Technische Univ. Muenchen, Garching, Germany, F.R. Fakultaet fuer Physik). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19946 (DOE/ER—0313/1, pp 53-68) **TRIPOS: A dynamic Monte Carlo code for the TRansport of Ions in POlyatomic Solids.** Chou, P.S.; Ghoniem, N.M. (Univ. of California, Los Angeles). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW. Contract FG03-84ER52110.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this work is to develop a new Monte Carlo code, TRIPOS, for the TRansport of Ions in POlyatomic Solids. The computer code is capable of simulating a large variety of ion/solid interaction phenomena for both bulk and surface applications. 60 refs., 12 figs.

19947 (DOE/ER/45162—3) **[A study of the interaction of light with sub-micron metallic surfaces: Final progress report].** Reifenberger, R.G. (Purdue Univ., Lafayette, IN (USA)). 1987. Contract FG02-84ER45162. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003138/JAW.

This program was largely concerned with the illumination of sub-micron metallic surfaces with intense laser light. This experimental arrangement, often referred to as photofield emission, is a technique that provides a convenient way of studying a variety of surface specific phenomena under intense laser illumination. Apart from the emphasis on small surfaces, the proposed experiments differ from conventional photoemission studies because a probe of the final state spectrum of emitted electrons populated by low photon energies can be readily achieved. Emphasis is therefore given to low photon energies and modest CW light intensities. An important feature of these experiments is the ability to investigate the effects of a strong applied electric field on the surface under illumination.

19948 (FEI—1782) **Vibration spectra of oxygen and vanadium atoms in vanadium-oxygen disordered interstitial alloys.** Danilkin, S.A.; Alenicheva, T.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703166/JAW.

The results of calculations of weighed frequency distributions (WFD) of oxygen and vanadium atoms in the disordered solid vanadium-oxygen solution containing 17% of oxygen are presented in the paper. The oxygen atoms in the alloy are shown to vibrate mainly with optical frequencies, the spectrum of which differs from the proper part of the spectrum of the alloy frequencies. The acoustic region in the oxygen WFD is sufficiently deformed in comparison with the spectrum of the alloy frequencies and its weight relatively to the optical part of the oxygen WFD spectrum is 1/20-1/40. 9 references, 7 figures.

19949 (IA—1427, pp 5-6) **Tensorial properties which can tell icosahedral symmetry from cubic or SO(3) symmetry.** Birman, J.L.; Goshen, S.Y. (City Univ. of New York, NY, USA; Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

19950 (INIS-BR—669, pp 31) **Molecular dynamic in A_2 Fe Cl_5 H_2O (A=NH_4,K) salts.** Partiti, C.S.M.; Piccini, A.; Rechenberg, H.R. (Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19951 (INIS-BR—669, pp 34) **Moessbauer study of the Sn/sub x/ NH/sub 3l-x/ system: phase dissolved in tin.** Saitovitch, E.M.B.; Rodrigues, E.; Drago, V.; Miklit, H. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Santa Catarina Univ., Florianopolis, Brazil; Bochum Univ., Germany, F.R.). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19952 (INIS-BR—669, pp 36) **Study by Moessbauer spectroscopy of the iron-gallic ink from a 18th century manuscript.** 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19953 (INIS-BR—669, pp 38) **Magnetic properties and electronic strucutre of pseudo-binary compounds of Laves phase type: perspectives.** Gomes, A.A.G. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19954 (INIS-BR—669, pp 40) **Studies of hyperfine magnetic fields in Heusler alloys of (Rh/sub 1-x/ Ni/sub x/)$_2$ MnSn.** Ramos, S.M.M.; Cunha, J.B.M. da; Schreiner, W.H. (Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19955 (INIS-BR—669, pp 42) **Study of hyperfine fields in sp site of Heusler alloys of Rh_2MnZ (Z=In, Sn, Sb) type by Moessbauer spectroscopy.** Ramos, S.M.M.; Cunha, J.B.M. da; Vasquez, A.; Jha, S. (Rio Grande do Sul Univ., Porto Alegre, Brazil; Cincinnati Univ., OH). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19956 (INIS-BR—669, pp 49) **Hyperfine interactions and magnetic transitions in R/sub 1.1/Fe_4B_4 (R=Y,La,Ce,Pr,Nd,Sm,Gd,Tb,Dy,Ho,Er,Lu).** Rechenberg, H.R.; Paduan Filho, A.; Missell, F.P. (Sao Paulo Univ., Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19957 (INIS-BR—669, pp 53) **Moessbauer effect of ^{197}Au, ^{193}Ir, ^{99}Ru in VH/sub x/ and ^{125}Te em PdH/sub x/.** Iannarella, L.V.; Zelger, M.; Wagner, F.E. (Universidade Federal Rural do Rio de Janeiro, Brazil; Muenchen Univ., Germany, F.R.). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19958 (INIS-BR—669, pp 9) **Moessbauer effect study of magnetic properties of Fe/sub 1-q/ Alq $0<q<0.5$, alloys in the disordered phase.** Alcazar, G.A.P.; Silva, E.G. da. (Minas Gerais Univ., Belo Horizonte, Brazil). 1986. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19959 (INIS-BR—669, pp 11) **Electronic structure, magnetic properties, Mossbauer isomer shifts and hyperfine fields of disordered Fe-rich Fe-Al alloys.** Chacham, H.; Silva, E.G. da; Guenzburger, D.; Ellis, D.E. (Minas Gerais Univ., Belo Horizonte, Brazil; Northwestern Univ., Evanston, IL). 1986. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19960 (INIS-BR—669, pp 12) **Microstructure of the Santa Catharina meteorite.** (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Minas Gerais Univ., Belo Horizonte, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19961 (INIS-BR—669, pp 14) **Fe-Ni phases in hi-rich iron meteorites.** (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro; Minas Gerais Univ., Belo Horizonte, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19962 (INIS-BR—669, pp 16) **Evolution of Fe-C compounds obtained by ion implantation and submitted to thermal treatment under pressure.** Oliveira, L.S. de; Silva, M.T.X.; Viccaro, P.J.; Jornada, J.A.H. da. (Santa Catarina Univ., Florianopolis, Brazil; Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19963 (INIS-BR—669, pp 17) **Thermal evolution of iron compounds obtained from carbon implantation in iron.** Oliveira, L.S. de; Silva, M.T.X.; Viccaro, P.J. (Santa Catarina Univ., Florianopolis, Brazil; Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19964 (INIS-BR—669, pp 19) **Metallic phase in chondrites.** (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19965 (INIS-BR—669, pp 21) **Hyperfine parameters of almondine by Moessbauer effect.** Cunha, J.B.M. da; Kunrath, J.I.; Vasquez, A.; Oliveira, J.C.P. de. (Rio Grande do Sul Univ., Porto Alegre, Brazil; Ceara Univ., Fortaleza, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19966 (INIS-BR—669, pp 22) **Moessbauer spectroscopy in Sn-Ta mineral.** Oliveira, J.C.P. de; Kunrath, J.I.; Vasquez, A. (Ceara Univ., Fortaleza, Brazil; Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19967 (INIS-BR—669, pp 24) **Analysis of temperature influence on hyperfine interactions in a Hedenbergite - acmite natural sample.** Oliveira, J.C.P. de; Vasquez, A.; Kunrath, J.I. (Ceara Univ., Fortaleza, Brazil; Rio Grande do Sul Univ., Porto Alegre, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19968 (INIS-BR—669, pp 26) **Synthetic ferrous hureaulite.** Moreira, L.F.; Mattievich, E.; Cano, F.H. (Rio de Janeiro Univ., Brazil; Instituto de Quimica Fisica Rocasalano, Madrid, Spain). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19969 (INIS-BR—669, pp 43) **Production and characterization of Sn/sub 1-x/Mn/sub x/ amorphous alloys.** Drago, V.; Saitovitch, E.M.B. (Santa Catarina Univ., Florianopolis, Brazil; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19970 (INIS-BR—669, pp 46) **Moessbauer study of Sn/sub 1-x/Mn/sub x/ amorphous alloys.** Drago, V.; Saitovitch, E.M.B. (Santa Catarina Univ., Florianopolis, Brazil; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19971 (INIS-BR—669, pp 52) **Study of the magnetic properties of the Laves phase $TiFe_2$.** Silva, E.G. da; Mansur, R.A.; Sa Barreto, F.C. de. (Minas Gerais Univ., Belo Horizonte, Brazil). 1986. NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19972 (INIS-BR—669, pp 55) **Study by Moessbauer Spectroscopy of the $(Mn, Fe)_3O_4$ natural ferrite - Jacobsite.** (Ceara Univ., Fortaleza, Brazil; Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19973 (INIS-BR—669, pp 56) **Systematic study of the substitution capability of ^{119}Sn implanted in silicon substrates.** Scherer, E.M.; Baumvol, I.J.R. 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19974 (CONF-8707146—1) **Photoacoustic studies of surface plasmons in metallic microstructures.** Inagaki, T.; Goudonnet, J.P.; Arakawa, E.T. (Oak Ridge National Lab., TN (USA); Osaka Kyoiku Univ. (Japan). Dept. of Physics; Dijon Univ., 21 (France). Lab. de Photoelectricite). 1987. Contract AC05-84OR21400. 8p. NTIS, PC A02; 3; GPO Dep. Order Number DE88004423/JAW.

From Conference on photoacoustic and photothermal phenomena; Heidelberg, F.R. Germany (27 Jul 1987).

Use of the photothermal method made it possible to explore new aspects of surface plasmon behavior in various types of metallic microstructures.

19975 **(CONF-8710254—3) Laser fluorescence spectroscopy of zinc neutrals originating from laser-irradiated and ion-bombarded zinc sulfide and zinc surfaces.** Arlinghaus, H.F.; Calaway, W.F.; Young, C.E.; Pellin, M.J.; Gruen, D.M.; Chase, L.L. (Argonne National Lab., IL (USA); Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-31109-ENG-38;W-7405-ENG-48. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006033/JAW.

From 19. annual symposium on optical materials for high power lasers; Boulder, CO, USA (26 Oct 1987).

Time-of-flight (TOF) measurements, employing high-resolution laser-induced fluorescence spectroscopy (LFS) as a probe, have been used to measure the yield and velocity distribution of Zn atoms ejected from a ZnS single crystal under irradiation by 308n nm photons. By comparison with the known ion sputtering yield for pure zinc, the absolute yield was determined to be 10^{10} atoms/pulse at a laser fluence of 30 mJ/cm^2. The velocity distribution of the Zn atoms could be fitted by a Maxwell-Boltzmann distribution, having characteristic temperature of ~2300°K. In addition, Doppler-shift techniques have been combined with TOF measurements in order to separate prompt from delayed emission of ablated atoms, as well as to probe possible molecular or cluster fragmentation. The results obtained suggest the possibility of molecular or cluster fragmentation. The results obtained suggest the possibility of molecular or cluster emission from ZnS. 17 refs., 7 figs.

19976 **(FEI—1755) Study of point-defect-impurity atom (He,Xe) complexes by channeling method.** Iskhakov, K.A.; Istomin, I.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko-Ehnergeticheskij Inst.). 1985. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703163/JAW.

The study of He problem in metals shows that helium capture into impurity traps may result at the early irradiation stages in gas pocket nucleus concentration increase, and at higher He concentrations - in the swelling rate decrease. The detailed analysis of these processes requires the determination of point-defect-impurity atom complex configuration. It is shown that when studying XeV/sub n/, He/sub m/XeV/sub n/ - type complexes it is advisable to use the method of oscillations of a flux of analysing ions, placed under plane channeling conditions. 17 references, 3 figures.

19977 **(IAE—4141/11) Group constants for calculation of charged particle slowing-down in multicomponent materials.** Lizunov, Yu.D.; Ryazanov, A.I.; Voloshchenko, A.M.; Germogenova, T.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703173/JAW.

The method of constant solution of calculation problems of charged particle slowing-down in a solid body is described. The method is based on the use of multigroup approximation, which is commonly used for the solution of neutron transfer theory problems. The method permits to calculate occurrence profiles of halted implanted charged particles in multicomponent materials (steels). 24 references, 3 figures.

19978 **(IAE—4172/11) Study of energy characteristics of interstitial type paired step on dislocation by molecular dynamics method.** Kevorkyan, Yu.R.; Kolomytkin, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703178/JAW.

Molecular dynamics method is used to study energy characteristics of paired step on the edge dislocation [100] (010) in iron alpha. Binding energies of atoms having different configuration in dislocation nucleus depending on the step length are obtained. Charge pattern of atomic migration along the dislocation nucleus in the field of other interstitial atom is calculated. The step different configurations are considered, and energy efficient sequence of their nucleation during irradiation is determined. 13 references, 2 figures, 3 tables.

19979 **(IAE—4224/6) Simulation of nucleation kinetics of radiation-induced defect clusters in irradiated materials.** Ryazanov, A.I.; Sidorenko, A.D.; Filippov, S.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 36p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703191/JAW.

A numerical method for simulation kinetics of radiation-induced defect clusters in irradiated materials is developed. Calculations of nucleation kinetics of radiation-induced defect clusters under pulsed irradiation corresponding to continuous irradiation of the thermonuclear reactor first wall are carried out. It is shown that under pulsed irradiation the concentration of nucleated dislocation loops doesn't practically differ from the concentration of loops nucleated at the same doses under continuous irradiation. The average size of dislocation loops nucleated under cyclic irradiation ($tau_1 = 10^3$ s, $tau_2 = 10^3$ s) at radiation time $tau = 2x10^4$ s is two times less than the average size of dislocation loops nucleated at the same time of continuous irradiation. Comparative analysis of nucleation kinetics of radiation-induced defect clusters is carried out for two models of linear dislocations: dislocations, being a continuous sink for point defects, and dislocations, being discrete sink for them. Account of microscopic processes occuring in dislocation nuclei (a model of discrete dislocation) is shown to lead to faster rates of nucleation and growth of dislocation loops, which values are similar to the values experimentally observed. 8 references, 11 figures, 2 tables.

19980 **(IAE—4267/11) Kinetics of dislocation step ensembles and edge dislocation climb in supersaturated solution of radiation-induced point defects.** Borodin, V.A.; Ryazanov, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 40p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703202/JAW.

Formation kinetics of step ensemble on the linear edge dislocation under conditions when supersaturated solution of radiation-induced point defects - vacancies and interstitials - was created in a material inder the effect of irradiation, is investigated. With regard to microscopic processes in dislocation nuclei the concentration of steps on the dislocation is found in a self-consistent way. Conditions under which the dislocations can be considered as discrete discharges for point defects so that the distance between dislocation steps exceeds considerably the average length of point defect free pass along the dislocation line are determined. The dislocation climb rate for the cases of material irradiation and annealing, which are of practical value, is found. Considerably nonlinear dependence of the dislocation climb rate on point defect supersaturation in material and its strong dependence on the temperature is demonstrated. 31 references, 3 figures.

19981 (INIS-BR—669, pp 18) **Effects of α ions post-bombardment on the thermal evolution of nitrogen precipitates in iron.** Behar, M.; Viccaro, P.J.; Silva, M.T.X.; Vasquez, A.; Santos, C.A. dos; Zawislak, F.C. 1986. (In Portuguese). NTIS (US Sales Only), PC A04/MF A01. Order Number DE87702777/JAW. (CONF-8512132—).

From 4. national meeting of Moessbauer spectroscopy; Rio de Janeiro, Brazil (11 Dec 1985).

19982 **(UCRL—96783-Rev.1) Fabrication and evaluation of transmissive multilayer optics for 8 keV x rays.** Bionta, R.M.; Jankowski, A.F.; Makowiecki, D.M. (Lawrence Livermore National Lab., CA (USA)). 21 Jan 1988. Contract W-7405-ENG-48. 10p. (CONF-871124—21-Rev.1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005644/JAW.

From Fall meeting of the Materials Research Society; Boston, MA, USA (30 Nov 1987).

We have made and tested several sliced multilayer structures which can function as transmissive x-ray optical elements (diffrac-

tion gratings, zone plates, and phase gratings) at 8 keV. Our automated multilayer sputtering system is optimized to sputter layers of arbitrary thickness for very large total deposits at high deposition rates. Diffraction patterns produced by the multilayer devices closely match theoretical predictions. Such transmissive optics have the potential for wide application in high resolution microscope and spectrometer systems. 13 refs., 10 figs.

6561 Superconductivity

REFER ALSO TO CITATION(S) 18536, 18636, 18639, 18652, 18653, 18658, 19939

19983 **(LBL—24323) An overview of recent developments in high-temperature superconductivity.** Falicov, L.M. (Lawrence Berkeley Lab., CA (USA); Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Oct 1987. Contract AC03-76SF00098. 7p. (CONF-8710266—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005477/JAW.

From Annual European ICASE seminar; Lyngby, Denmark (9 Oct 1987).

The BCS theory, in all probability, will explain the properties of new superconducting oxide materials. However, a detailed account of why they have such an unusually high transition temperature will require much more work. The key to the answer to the theoretical questions may be found in the fact that all these materials are ceramics, i.e., bad conductors in their normal phase. In fact, they are "almost insulators", with strange and varied magnetic properties. And although the lattice polarization will certainly play a role (as shown by the isotope effect), the detailed motion of the electrons and the short-range Coulomb repulsion may give the unusual characteristics which result in high transition temperatures. From the point of view of practical applications and their implications in our everyday life, much can be speculated: transmission lines without any power losses, levitated trains, super-super-computers, new and not-yet-invented devices. But all these innovations will require the solution of complicated (and expensive to solve) materials problems (brittle, hard to handle ceramics; unstable phases; low critical currents) as well as a cool-headed economic analysis which this author is unable to provide. 13 refs.

6570 Theoretical And Mathematical Physics

REFER ALSO TO CITATION(S) 18730, 18881, 19714, 20003, 20141, 20662

19984 **(AD-A—186012/1/XAB) Stochastic differential equations in duals of nuclear spaces with some applications. Technical report, 30 September 1985-30 September 1986.** Kallianpur, G. (North Carolina Univ., Chapel Hill (USA). Center for Stochastic Precesses). Oct 1986. 88p. (TR—158). NTIS, PC A05/MF A01.

These lectures aim at giving an elementary introduction to certain types of stochastic differential equations in infinite dimensional spaces. One lecture introduces countably Hilbertian Nuclear (CHN) spaces and give some examples to illustrate why these infinite dimensional spaces are convenient for the study of some practical problems, e.g., those occuring in stochastic evolutions. This lecture assumes a complete probability space with a right continuous filtration. It also assumes a given Countably Hilbertian nuclear space. Ornstein-Uhlenbeck stochastic differential equations on duals of nuclear spaces introduces a special class of linear stochastic differential equations with values in duals of nuclear spaces, namely Ornstein-Uhlenbeck type processes with a nuclear-valued martingale as a driving term. Weak Convergence of Solutions: the weak convergence of the solutions of to the corresponding stochastic differential equations driven by a Gaussian noise are considered. This last lecture gives an outline of recent works on stochastic evolution equations and nonlinear stochastic differential equations on the dual of a Countably Hilbert nuclear space.

19985 **(AD-A—186128/5/XAB) Properties of a magnetic dipole. Technical note.** Ryan, P.J. (Materials Research Labs., Ascot Vale (Australia)). Jun 1987. 15p. (MRL-TN—521). NTIS, PC A03/MF A01.

Magnetic phenomena differ from electric phenomena as there are no free magnetic charges or poles. The basic entity in magnetic phenomena is thus the magnetic dipole - the magnetic analogue of the electric dipole consisting of two opposite charges placed very close together. Bulk magnetic phenomena such as magnetization are generally described in terms of accumulations of magnetic dipoles. However standard works on electromagnetism usually describe only the simple features of the dipole without verifying all its properties. This note explores the physical and mathematical properties of the classical magnetic dipole. These properties enable the dipole to be considered as one of the fundamental magnetostatic units.

19986 **(ORNL—6425) Engineering Physics and Mathematics Division progress report for period ending September 30, 1987.** (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 269p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE88006141/JAW.

This report provides an archival record of the activities of the Engineering Physics and Mathematics Division during the period June 30, 1985 through September 30, 1987. Work in Mathematical Sciences continues to include applied mathematics research, statistics research, and computer science. Nuclear-data measurements and evaluations continue for fusion reactors, fission reactors, and other nuclear systems. Also discussed are long-standing studies of fission-reactor shields through experiments and related analysis, of accelerator shielding, and of fusion-reactor neutronics. Work in Machine Intelligence continues to feature the development of an autonomous robot. The last descriptive part of this report reflects the work in our Engineering Physics Information Center, which again concentrates primarily upon radiation-shielding methods and related data.

19987 **(UCRL—97418) The automated symbolic derivation of state equations for dynamic systems.** Macfarlane, J.; Donath, M. (Lawrence Livermore National Lab., CA (USA); Minnesota Univ., Minneapolis (USA)). Sep 1987. Contract W-7405-ENG-48. 15p. (CONF-880315—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000968/JAW.

From 4. IEEE conference on artificial intelligence applications; San Diego, CA, USA (14 Mar 1988).

A system which is capable of generating symbolic state equations for dynamic systems is described. The underlying object-oriented knowledge representation structure is based on the bond graph modelling methodology which abstracts a complex system into a network of simple relations that describe the behavior of the system. Constraint propagation techniques provide a method for determining the causal relationships that must exist between system variables in a state determined system, thereby identifying a set of state variables for the system. The relation network and the state variables are manipulated by MACSYMA to define the state equations for the physical system dynamics. The availability of state equations in symbolic form allows the engineer to assess the influence of component parameters on the overall function of the physical system without having to resort to simulation iterations. This representation establishes the foundation for a model based reasoning system currently under development. 8 refs., 10 figs., 3 tabs.

19988 **(UCRL—97680) Particle-dynamics calculations of gravity flow of inelastic, frictional spheres.** Walton, O.R.; Braun, R.L.; Mallon, R.G.; Cervelli, D.M. (Lawrence Livermore National Lab., CA (USA)). 17 Nov 1987. Contract W-7405-ENG-48. 10p. (CONF-8710262—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005224/JAW.

From US-Japan symposium on micromechanics of granular materials; Sendai, Japan (26 Oct 1987).

Three-dimensional discrete-particle computer models that calculate the motion of each individual grain in assemblies of hundreds of particles in steady shearing flows with either periodic or real boundaries have been modified to simulate gravity flow of particles through arrays of cylindrical horizontal rods and down inclined chutes. The particle interaction models reproduce experimentally measured recoil trajectories for colliding frictional particles, including rotation effects. Laboratory measurements of the flow of glass beads cascading down through an array of horizontal cylindrical rods correlate well with gravity flow calculations of inelastic,

frictional spheres falling through a similar rod array. Less elastic particles are found to cascade through the array faster than nearly elastic particles. Likewise, smaller particles are found to flow faster than large ones. Model simulations of nearly two-dimensional inclined chute flow tests of 6mm diameter cellulose-acetate spheres flowing over a rough surface between parallel vertical glass plates, result in particle velocities that are considerably higher than values measured in similar laboratory tests at UCLA; however, inclusion of approximate air drag effects in the calculational model eliminates most of the discrepancy producing both density and velocity profiles that are close to the measured values. 15 refs., 5 figs.

19989 (DOE/ER—0313/1, pp 44-52) **Full derivation of an approximate solution to the scattering integral for general interatomic potentials.** Blanchard, J.P.; Ghoniem, N.M.; Chou, S.P. (Univ. of California, Los Angeles). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW. Contract FG03-84ER52110.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this work is to develop a new analytical approximation for the calculation of the scattering integral in atomic collisions. The method can be applied to any arbitrary interatomic potential. 8 refs., 8 figs., 2 tabs.

19990 (DOE/ER/13687—1) **Two studies of nonlinear processes in irreversible thermodynamics: Annual performance report first year, May 1, 1987-April 30, 1988.** Kestin, J. (Brown Univ., Providence, RI (USA). Div. of Engineering). Jan 1988. Contract FG02-87ER13687. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005794/JAW.

This paper discusses two nonlinear irreversible processes: Inelastic deformation and two-phase flow. (LSP)

19991 (GSI—87-66(prepr.)) **Continuum solutions of the Klein-Gordon equation.** Jansen, G.; Pusch, M.; Soff, G. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Oct 1987. 46p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752236/JAW.

We construct explicit solutions of the Klein-Gordon equation for continuum states. The role of the energy in the single-particle Klein-Gordon theory is elucidated. Special emphasis is laid on the determination of resonance states in the continuum for overcritical potentials. As examples for long-range interaction we depict solutions for the Coulomb potential of a point-like nucleus as an extended nucleus. The square-well potential and the exponential potential are treated to exemplify pecularities of short-range interactions. We also derive continuum solutions for a scalar interaction of square-well type. Finally we discuss the behaviour of a spin-0 particle in an external homogeneous magnetic field.

19992 (IAE—4174/1) **Discussion between Einstein and Bohr about the essence of quantum mechanics.** Morozov, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 37p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703179/JAW.

The so-called Einstein, Podolski and Rozen paradox in all its variants is shown not to exist: quantum mechanics doesn't allow both joint direct measurement of non-permutable (complementary according to Bohr) observables and separate indirect measurements of any so-called kinematic observables, suggested in different variants of the paradox, due to the absence in quantum mechanics necessary for such measurements of functional couplings observed at the initial and final states of measurements (absence of the corresponding conservation laws). Reasons, giving evidence about absence in orthodox quantum mechanics of the so-called kinematic observables and based on the absence in quantum mechanics of the preservation laws for hypothetic kinematic observables and on the impossibility of introduction of such laws not refusing from the principles of quantum mechanics (existence of definite and corresponding measured kinematic observables of any object should involve definiteness of the corresponding dynamic observables, as dynamic observables are classically measured through kinematic ones, but not vice versa), are discussed. 19 references.

19993 (IAE—4198/1) **Hyperspherical expansion in the many-body Coulomb problem.** Frolov, A.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703188/JAW.

The limit capabilities of hyperspherical harmonic (HH) method in many-body Coulomb problem are considered. Iterative scheme, allowing one to take account of thousands and dozens of thousands of basis states is presented. It is shown, that beginning with K-tilde/sub max/ it is not possible to take account of all of the HH but only of the main ones which appears to be a particular supersymmetry of hyperspherical expansion. Though the calculated energy function from K/sub max/ is of a step-by-step character, it appears to be possible to use simple asymptotic formulas, allowing one to considerably correct the answer. When 1^1S-state energy of / sup ∞/He is determined in such a way the error may be no less than 1.05×10^{-5}, and with 2^1S - less than 0.5×10^{-4} of relative units. 27 references, 4 tables.

19994 (IFT-P—22/87) **Efimov effect, Thomas effect and model dependence of three-particle observables.** Adhikari, S.K.; Delfino, A.; Frederico, T.; Goldman, I.D.; Tomio, L. (Pernambuco Univ., Recife, Brazil. Dept. de Fisica; Universidade Federal Fluminense, Niteroi, Brazil. Inst. de Fisica; Centro Tecnico Aeroespacial, Sao Jose dos Campos, Brazil. Inst. de Estudos Avancados; Sao Paulo Univ., Brazil. Inst. de Fisica). (Instituto de Fisica Teorica, Sao Paulo (Brazil)). 1987. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701445/JAW.

It is demonstrated for the three-dimensional three-particle system that a divergence arising from essentially the same singularity structure of the Kernel of the scattering integral equation is responsible for both the Efimov and Thomas effects. The above divergence implies that the results of three-particle dynamical calculation be sensitive to the details of the two-particle interaction. In two-dimensional systems the above divergence is absent and consequently the three-particle observables become essentially model independent. (M.W.O.).

19995 (INP—1260/PL) **Newtonian form of wave mechanics.** Kapuscik, E. (Institute of Nuclear Physics, Krakow (Poland)). 1984. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701355/JAW.

Following the general principles of both Newton's mechanics and quantum mechanics a new formulation of wave mechanics is proposed. The new basic equations do not contain physical parameters and admit a different interpretation of the Planck constant.

19996 (ITEF—67(1987)) **Spectral Riemann surfaces of Sturm-Liouville operators and quasi-exactly-soluble problems.** Turbiner, A.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 11p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701489/JAW.

It is shown that there exists for each exactly-soluble problem (in sense of Infeld-Hull factorization method) the associated quasi-exactly-soluble one, for which the first N-th eigenstates are known exactly. These problems contains some free parameters and the first N-th states form the N-sheet Rieman surface, which is separated from the whole spectral, infinitely-sheet - Riemann surface. In the limit $N \to \infty$ the plaited eigenvalues are unplaited and the ordinary exactly-soluble problem appears. 10 refs.

19997 (ITEP—55(1987)) **Spectral singularities and quasi-exactly-soluble quantal problem.** Turbiner, A.V.; Ushveridze, A.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701493/JAW.

The analytic structure of a few first eigenvalues in the quasi-exactly-soluble model of the sextic anharmonic oscillator are studied. It is shown that the Riemann surface of the coupling constant is divided into two parts. 10 refs.

19998 **(LAPP-TH—163) Gauged BRST symmetry and the occurence of higher cocycles in quantum field theory.** Baulieu, L.; Grossman, B.; Stora, R. (Grenoble-1 Univ., 74 - Annecy (France). Lab. de Physique des Particules). Jun 1986. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87753202/JAW.

The BRST symmetry of Yang Mills theories can be gauged via the introduction of an anticommuting single gauge field. There follows the construction of a local BRST operation which allows an algebraic analysis of the BRST current algebra. This construction provides, in particular, a field theory interpretation of most higher cocycles which accompany the usual chiral anomaly.

19999 **(UWThPh—1987-27) On the level order for Dirac operators.** Grosse, H. (Vienna Univ., Austria. Inst. fuer Theoretische Physik). (Vienna Univ. (Austria)). 1987. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701534/JAW.

We start from the Dirac operator for the Coulomb potential and prove within first order perturbation theory that degenerate levels split in a definite way depending on the sign of the Laplacian of the perturbing potential. 9 refs.

20000 **(IAE—4159/1) Lorentz transformations in terms of quaternions.** Smolin, A.L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703174/JAW.

Transformations differ from Lorentz ones by absence of y'=y; z'=z requirements in case of V/sub x/=V; V/sub y/=V/sub z/=0 are suggested. General transformations for optional V-vector are obtained. The given approach natural language is that of hypercomplex numbers. Some consequences of similar transformations in special relativity theory are discussed. Their relation to helical calculus, to polarization and spin properties of moving with relativistic velocities objects is underlined. These transformations matrix formulation is presented. 14 references.

20001 **(IAE—4166/1) Constrained configurations in general relativity theory.** Solov'ev, L.S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 37p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number DE87703176/JAW.

The method for solution of the general relativity theory (GRT) equations for finding constrained stationary gravitating configurations based on the principle of conformity with the Newton theory is considered. Consequent use of the required condition of existence of proper limiting transition for weak gravitational fields leads to unique solution of considered physical problems within the GRT. In case of spherical symmetry the obtained by the above method natural metric coincides with the known isotropic metric. Some precise and approximate solutions for cases of cylindrical, spherical and axial symmetry are derived. 12 references.

20002 **(JINR-E—2-87-209) Towards a finite quantum gravity.** Kazakov, D.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number TI88701497/JAW.

Submitted to the journal JETP - Lett. .

It is shown that in Einstein quantum gravity one can achieve the cancellation of all the ultraviolt divergences on mass shell by an appropriate choice of the background metric. In the framework of dimensional regularization g/sub $\mu\nu$//sup B/=Σ g/sub $\mu\nu$//sup (k)/ x ϵ/sup k/, where the classical metric g/sub $\mu\nu$//sup (0)/ obeys the Einstein equation R/sub $\mu\nu$/(g/sup (0)/=00. 8 refs.

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20003 **(AD-A—185920/6/XAB) Texting the formulary: a collection of examples of the use of TEX to produce ruled tables and displayed equations. Memorandum report.** Book, D.L.; Brun, T.; Scotgt, R.J. (Naval Research Lab., Washington, DC (USA)). 6 Oct 1987. 138p. (NRL-MR—6044). NTIS, PC A07/MF A01.

The NRL Plasma Formulary is a collection of formulas and reference data in a handy pocketsized booklet. This report contains some sixty pages of text, tables, and displayed equations, together with the associated TEX files. An enlarged copy (the output from an IMAGEN ink-jet printer) of each page of the Formulary, identical with that which was photographically reduced for the actual book, is reprinted facing the TEX source code that generated it. Users can browse through the report until they come to a table or displayed equation similar to the one they want to produce, then extract from the facing page the control sequences they need.

20004 **(INDC(NDS)—186/GA) Sixth meeting of the Atomic and Molecular Data Centre Network: Summary report.** Lorenz, A. (International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section). Nov 1986. 38p. (CONF-860994—Summ.). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900317/JAW.

From IAEA specialists' meeting of the IFRC subcommittee on atomic and molecular data for fusion; Vienna, Austria (8 Sep 1986).

This report is a summary of the Sixth A + M Data Centre Network Meeting convened by the IAEA Headquarters, Vienna, Austria, on 10 to 12 September 1986. The meeting was attended by ten representatives of centres from four Member States concerned with the coordination of the international management of atomic and molecular data pertinent to controlled fusion research technology.

20005 (ORNL—6332, pp 347-357) **Management services, quality assurance, and safety.** Oct 1987. NTIS, PC A19/MF A01. Order Number DE88003651/JAW.

In Fusion Energy Division annual progress report period ending December 31, 1986.

Broad technical and administrative support for the programmatic research and development activities of the Fusion Energy Division is provided by the Management Services Section and by the division's quality assurance (QA) and safety programs. Support is provided through effective communication with division programmatic staff and through the coordination of resources from disciplines outside the division. The QA activity in the division emphasizes the development and documentation of a QA program that conforms to national standards, the review and approval of engineering documents, supplier surveillance, identification and documentation of nonconforming items, audits, and QA assessments/plans. The division's safety activities include a formal safety program, emergency planning activities, and environmental protection services. Efforts devoted to the removal of hazardous wastes from division facilities were expanded during 1986.

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REFER ALSO TO CITATION(S) 18883, 18883, 18884, 18884, 18885, 18885, 18886, 18886, 19739, 20153, 20154, 20155, 20163, 20163, 20164, 20170, 20177, 20220, 20270, 20272, 20351, 20385, 20501

20006 **(DOE/ER—0356) Summaries of FY 1986 research in the Applied Plasma Physics Fusion Theory Program.** (USDOE Office of Energy Research, Washington, DC. Applied Plasma Physics Div.). Dec 1987. 157p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88004242/JAW.

The Theory Program is charged with supporting the development of theories and models of plasmas for the fusion research effort. This work ranges from first-principles analysis of elementary plasma processes to empirical simulation of specific experiments. The Theory Program supports research by industrial contractors, US government laboratories, and universities. The university sup-

port also helps to fulfill the DOE mission of training scientists for the fusion program. The Theory Program is funded through the Fusion Theory Branch, Division of Applied Plasma Physics in the Office of Fusion Energy. The work is divided among 31 institutions, of which 19 are universities, five are industrial contractors, and seven are US government laboratories; see Table 1 for a complete list. The FY 1986 Theory Program budget was divided among theory types: toroidal, mirror, alternate concept, generic, and atomic. Device modeling is included among the other funding categories, and is not budgeted separately.

20007 (IA—1427, pp 47-48) **Effect of plasma-substrate interactions on the promotion of chemical bonding between thin films and substrates.** Khait, Y.L.; Carmi, U.; Inspektor, A.; Avni, R. (Ben-Gurion Univ. of the Negev, Beersheba, Israel; Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

20008 (IA—1427, pp 48) **Correlation between plasma parameters and the deposition of μC-Si films by plasma of argon and hydrogen.** Avni, R.; Carmi, U.; Manory, R.; Grill, A.; Grossman, E. (Israel Atomic Energy Commission, Tel Aviv; Ben-Gurion Univ. of the Negev, Beersheba, Israel). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

20009 (IAE—4203/7) **Problem of ion energy cost in a hydrogen plasma.** Chekalin, G.G. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703189/JAW.

Energy consumption for the production of ion-electron pair (ion cost) from H_2 molecule in optically thin hydrogen plasma is calculated. The effect of losses related to electronic structure excitation on ion cost is analyzed. It is shown that energy necessary for ion formation, due to excitation of electron states of H_2 molecule varies from the prevailing one at the temperature of plasma electrons T/sub e/ = 2.5 eV to the noticeable one at T/sub e/ = 20 eV. Excitation cross sections of H_2 electron states, the excitation of which makes the main contribution to the losses, are presented. Rates of the corresponding processes are calculated. Ion energy cost E/sub i/ depending on T/sub e/ is found. E/sub i/ is compared with experimentally measured value. 11 reference, 5 figures.

20010 (INIS-mf—4754(no.36)) **International Bulletin on Atomic and Molecular Data for Fusion. No. 36.** Smith, J.J. (ed.). (International Atomic Energy Agency, Vienna (Austria). Atomic and Molecular Data Unit). Oct 1987. 108p. NTIS (US Sales Only), PC A06/MF A01. Order Number TI88701476/JAW.

The bulletin provides information on atomic and molecular data relevant for fusion research. In Part I the indexed papers are listed separately for structure and spectra, atomic and molecular collisions and surface interactions. Part II contains all the bibliographic data for both the indexed and non-indexed references (555 references). An author index is included.

20011 (JAERI-M—87-168) **Studies on fundamental technologies for producing tokamak-plasma.** Matsuzaki, Yoshimi. (Japan Atomic Energy Research Inst., Tokyo). Oct 1987. 150p. (In Japanese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751993/JAW.

The report describes studies on fundamental technologies to produce tokamak-plasma of the JFT-2 and JFT-2M tokamaks. (1) In order to measure the particle number of residual gases, calibration methods of vacuum gauges have been developed. (2) Devices for a Taylor-type discharge cleaning (TDC), a glow discharge cleaning (GDC) and ECR discharge cleaning (ECR-DC) have been made and the cleaning effects have been investigated. In TDC the most effective plasma for cleaning is obtained in the plasma with 5 eV of electron temperature. GDC is effective in removing carbon impurities, but is less effective for removing oxygen impurities. ECR-DC has nearly the similar effect as TDC. The cleaning effect of these three types were studied by comparing the properties of resulting tokamak plasmas in the JFT-2M tokamak. (3) Experimental studies of pre-ionization showed as following results; A simple pre-ionization equipment as a hot-electron-gun and a J x B gun was effective in reducing breakdown voltage. An ordinary mode wave of the electron cyclotron frequency was very effective for pre-ionization. The RF power whose density is 3.6 x 10/sup -2/ W/cm/sup 3/ produced plasma of an electron density of 5 x 10/sup 11/ cm/sup -3/. In this case, it is possible to start up with negligible consumption of the magnetic flux caused by the plasma resistance. (4) Concerning to studies on plasma control, the following results were obtained; In order to obtain constant plasma current, a pulse forming network was constructed and sufficient constant plasma current was achieved. In applying an iso-flux method for measuring the plasma position, it is no problem practically to use only one loop-coil and one magnetic probe.

20012 (NRL-MR—6057) **Characterization of PEOS plasma parameters and conduction phase properties.** Commisso, R.J.; Hinshelwood, D.D.; Neri, J.M.; Oliphant, W.F.; Weber, B.V. (Naval Research Lab., Washington, DC (USA)). 31 Dec 1987. Contract AI08-79DP40092. 69p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE88005629/JAW.

This report is a compilation and summary of data, previously presented in numerous and disparate forums, that characterize the initial plasma parameters and conduction phase of the plasma erosion opening switch. The results verify the approximate values of the parameters used in modeling the switch and support the current controlled erosion switch theory. 19 refs., 29 figs.

20013 (PB—88-128731/XAB) **Starpower: the US and the international quest for fusion energy.** (Office of Technology Assessment (U.S. Congress), Washington, DC). Oct 1987. 247p. (OTA-E—338). NTIS, PC A11/MF A01.

Also available from Supt. of Docs.; Library of Congress catalog card No. 87-619854.

This report, requested by the House Committee on Science, Space, and Technology and endorsed by the Senate Committee on Energy and Natural Resources, reviews the status of magnetic-confinement fusion research and compares its progress with the requirements for development of a useful energy technology. The report does not analyze inertial-confinement fusion research, which is overseen by the House and Senate Armed Services Committees. Contents include: Executive Summary; Introduction and overview; History of fusion research; Fusion science and technology; Fusion as an energy program; Fusion as a research program; Fusion as an international program; Future paths for the magnetic-fusion program; Appendixes--(Non-electric applications for fusion, Other approaches to fusion, Data for figures, List of acronyms and glossary).

20014 **Advanced Toroidal Facility.** Taylor, D.J. (Oak Ridge National Lab., TN, USA). pp 643-648 of Fusion technology 1986. 2 volumes. Proceedings of the fourteenth symposium, Avignon (FR), 8-12 September 1986. Oxford, England; Pergamon Press (1986). (EUR—10936-EN; CONF-860917—). Contract AC05-84OR21400.

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

The Advanced Toroidal Facility (ATF) is a magnetic confinement device under construction at Oak Ridge National Laboratory (ORNL). The ATF is a type of stellarator known as a torsatron, which theoretically has the capability to operate at ≧ 8% beta in steady state. The achievement of high beta is made possible by the carefully chosen combination of helical and poloidal magnetic field coils, which gives direct access to the so-called second stability region. In addition, the device has the flexibility to explore the stability boundaries and to study the properties of a variety of magnetic configurations, including some with a helical magnetic axis. The ATF plasma has a major radius of 2.1 m, an average minor radius of 0.3 m, and a field of 2 T for 5-s pulses or 1 T steady state. The ATF replaces the Impurity Study Experiment (ISX-B) tokamak at ORNL and uses the ISX-B auxiliary systems, including power supplied, cooling, diagnostics, data acquisition,

control, and 4 MW of neutral injection and 0.2 MW electron cyclotron heating. An overview of the ATF device is presented, including details of the construction process employed and the present status of this work.

20015 **Physics guidelines for the Compact Ignition Tokamak.** Sheffield, J. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **52**: 132-133(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The goal of the Compact Ignition Tokamak (CIT) Program is to provide a cost-effective route to the production of a burning deuterium-tritium plasma so that alpha particle effects may be studied. The work in this program began with three design teams, situated at the Massachusetts Institute of Technology, Princeton Plasma Physics Lab. and the Oak Ridge National Lab. Fusion Engineering Design Center. The criteria for the CIT design are provided by the Ignition Technical Oversight Committee (ITOC). An assessment of the role of a CIT has been made by the Magnetic Fusion Advisory Committee's Panel XIV. Assisting the design teams and ITOC is an Ignition Physics Studies Group, which provides community assessments of the status of tokamak research in experiment, theory, and modeling. The physics guidelines are in the areas of confinement, plasma shaping, operational limits, startup, plasma control, ion cyclotron heating, alpha physics, and diagnostics.

20016 **System studies of Compact Ignition Tokamaks.** Galambos, J.D.; Peng, Y.K.M.; Blackfield, D.T. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **52**: 133-135(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

A new version of the Oak Ridge National Lab. Fusion Engineering Design Center (FEDC) Tokamak System Code (TSC) has been developed to analyze the compact ignition tokamak (CIT). These proposed experiments have small (major radius $\leqq$ 1.5 m) and high-magnetic fields (B $\sim$ 10T), and are characterized by a lower cost than was estimated for the Tokamak Fusion Core Experiment studies. Key design constraints of CIT include limits to the high stress levels in the magnetic coils, limits to the large temperature rises in the coils and on the first-wall or divertor plate, minimizing power supply requirements, and assuring adequate plasma performance in fusion ignition and burn time consistent with the latest physics understanding. We present systems code level studies of CIT parameter space here for a range of design options with various design constraints.

20017 **Twenty years of plasma physics.** Mc Namara, B. Teaneck, NJ; World Scientific Pub. Co. (1985). 357p. (CONF-840932—). World Scientific Pub. Co., 687 Hartwell Street, Teaneck, NJ 07666.

From Meeting on plasma physics; Trieste, Italy (24 Sep 1984).

The first major activity at the International Centre for Theoretical Physics was the International Seminar on Plasma Physics held in Trieste from October 5-31, 1964. followed in 1965 by a highly successful full year's working group activity in plasma theory. This volume, Twenty Years of Plasma Physics, represents a commemoration of the 1964 Seminar, hopefully will be similarly useful, and provides an opportunity to ponder the trends of the intervening years. Space plasma physics now plays an important role in the world's space programs. A good understanding of the earth's magnetosphere has emerged, and the important role of interstellar and intergalactic magnetoplasmas is gradually being appreciated. Study of the sun's magnetic activity is now an active field of research. Dynamo theory and tearing instability studies are key both to solar research and to understanding such magnetic fusion experiments as the reversed field pinch.

20018 **Computational plasma physics and supercomputers.** Killeen, J.; Mc Namara, B. (National Magnetic Fusion Energy Computer Center). pp 104-133 of Twenty years of plasma physics. Mc Namara, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-840932—).

From Meeting on plasma physics; Trieste, Italy (24 Sep 1984).

The Supercomputers of the 80's are introduced. They are 10 - 100 times more powerful than today's machines. The range of physics modeling in the fusion program is outlined. New machine architecture will influence particular models, but parallel processing poses new programming difficulties. Increasing realism in simulations will require better numerics and more elaborate mathematical models.

20019 **(CONF-861110—11) The ORNL stellarator program.** Lyon, J.F. (Oak Ridge National Lab., TN (USA)). Nov 1986. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004424/JAW.

From American Physical Society Plasma Physics Division meeting; Baltimore, MD, USA (3 Nov 1986).

The main focus of magnetic confinement studies at Oak Ridge National Laboratory (ORNL) is stellarator research. The principal elements of the ORNL stellarator program are the Advanced Toroidal Facility (ATF), stellarator theory, and related plasma technology development. These elements are discussed breifly. 2 figs., 1 tab.

20020 **(CONF-871179—2-Vugraphs) ATF experimental plans.** Murakami, M. (Oak Ridge National Lab., TN (USA)). 10 Nov 1987. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004177/JAW.

From US/Japan heliotron-stellarator workshop; Oak Ridge, TN, USA (9 Nov 1987).

The Program is directed at better understanding and improvement of toroidal confinement through studies of: β limit; 2nd stability region; low nu* transport; role of E-field; effects of magnetic configurations (externally controlled) on β and transport; and issues critical to steady state operation (energy and particle handling, ICRF).

20021 **(CONF-871179—4-Vugraphs) Currents in ATF.** Carreras, B.A.; Shaing, K.C.; Dominguez, N.; Lynch, V.E.; Tolliver, J.S. (Oak Ridge National Lab., TN (USA)). 12 Nov 1987. Contract AC05-84OR21400. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004172/JAW.

From US/Japan heliotron-stellarator workshop; Oak Ridge, TN, USA (9 Nov 1987).

This paper contains viewgraphs on the existence of currents in ATF Torsatron. Current sources like bootstrap, Pfirsch-Schluter, beam driven and flux conserving are investigated and suggestions on minimization are given. (LSP)

20022 **(CONF-871179—10-Vugraphs) Suppression of x-rays generated by runaway electrons in ATF.** Rasmussen, D.A.; England, A.C.; Eberle, C.C.; Devan, W.R.; Harris, J.H.; Jernigan, T.C.; Kindsfather, R.R.; Morris, R.N.; Murakami, M.; Neilson, G.H. (Oak Ridge National Lab., TN (USA); Kyoto Univ. (Japan)). 1987. Contract AC05-84OR21400. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004179/JAW.

From US/Japan heliotron-stellarator workshop; Oak Ridge, TN, USA (9 Nov 1987).

X-ray emission from runaway electrons on ATF is a serious issue. Runaway suppression techniques used on Heliotron-E are not adequate for ATF. Three approaches have been developed to suppress runaway production. Monitoring devices have been installed in occupied areas and personnel access and exposure will be limited. Additional shielding will be added as required. These systems will be ready for installation and testing on ATF prior to commissioning or first plasma operation.

20023 **(CONF-871179—11-Vugraphs) Low aspect ratio torsatrons.** Carreras, B.A.; Dominguez, N.; Garcia, L.; Lynch, V.E.; Lyon, J.F.; Cary, J.R.; Hanson, J.D.; Navarro, A.P. (Oak Ridge National Lab., TN (USA); Colorado Univ., Boulder (USA); Auburn Univ., AL (USA); Universidad Complutense de Madrid (Spain). Dept. de Fisica Teorica). 1987. Contract AC05-84OR21400. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004173/JAW.

From US/Japan heliotron-stellarator workshop; Oak Ridge, TN, USA (9 Nov 1987).

This paper discusses a move toward a more compact stellarator that could be a more attractive fusion reactor.

20024 **(CONF-8706119—2-FP) Problems in modeling TF ripple loss of fast alphas from a tokamak reactor.** Hively, L.M. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000612/JAW.

From Workshop on alpha particle effects in ETR; Washington, DC, USA (15 Jun 1987).

The present status of modeling TF ripple loss of fast alphas from tokamaks is summarized. The modeling issues are discussed, and several new aspects of this problem are described, including gyromotion, radial electric field, and sawtoothing. Existing models predict that TF ripple loss of fast alphas will have a low-to-moderate impact on the design of a tokamak engineering test reactor (ETR). 52 refs., 3 figs., 2 tabs.

20025 **(DOE/ER/13723—1) The Magnetically Insulated Inertial Confinement Fusion (MICF): A novel approach: Progress report, June 1, 1987-December 31, 1987.** Kammash, T. (Michigan Univ., Ann Arbor (USA). Dept. of Nuclear Engineering). Jan 1988. Contract FG02-87ER13723. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005460/JAW.

The Magnetically Insulated Inertial Confinement Fusion (MICF) concept represents a new and a novel approach to fusion power. It combines the favorable aspects of both magnetic and inertial fusions in that physical containment of the plasma is provided by the metallic shell that surrounds the solid fuel pellet, while insulation of its thermal energy is provided by a very strong, self-generated magnetic field. The plasma of interest is formed at the core of the pellet as a result of ablation of the solid fuel wall by a laser beam that enters the target through a hole. In addition to heating the plasma the laser beam contributes to the formation of the instantaneous magnetic field that serves to impede the energy flow from the hot plasma to the wall. In a reactor scenario the core plasma would be a high beta (ratio of plasma pressure to magnetic field pressure) plasma and as a result the magnetic field does not provide confinement as in magnetic fusion but serves as a thermal insulator. Our major thrust thus far has been to model the plasma in such a system and, in so doing, identify the major physics and technological problems that must be addressed in order for MICF to become a viable fusion reactor. Many simplifying assumptions were made in order to make the problem analytically (and computationally) tractable. In what follows a brief discription of the model along with the underlying assumptions will be presented and analyzed. The conclusions that will be drawn from this model will serve as the basis of future work that will be highlighted in the renewal proposal.

20026 **(DOE/ER/51088—T20) Toroidal confinement research concepts evaluation and tradeoff studies: Project status report, September 1, 1987-September 30, 1987.** (InterScience, Inc., Troy, NY (USA)). 1987. Contract AC01-85ER51088. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004277/JAW.

This paper investigates different conceptual aspects of toroidal confinement. Topics covered include energy multiplication factors for the TFTR tokamak, CIT physics and engineering, and JET auxiliary heating and energy multiplication factors. (LSP)

20027 **(DOE/ER/51088—T22) Toroidal confinement research concepts evaluation and tradeoff studies: Project status report, November 1, 1987-November 30, 1987.** (InterScience, Inc., Germantown, MD (USA)). 25 Jan 1988. Contract AC01-85ER51088. 9p. NTIS, PC A02. Order Number DE88004841/JAW.

Progress and conclusions drawn from attendance at a meeting of the Division of Plasma Physics, American Physical Society, held in San Diego, California. (DWL)

20028 **(DOE/ER/53220—T3) Third and fourth quarter progress report on plasma theory and simulation, July 1-December 31, 1986.** Birdsall, C.K. (California Univ., Berkeley (USA). Electronics Research Lab.). 1987. Contract FG03-86ER53220. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003620/JAW.

Our group uses theory and simulation as tools in order to increase the understanding of plasma instabilities, heating, transport, plasma-wall interactions, and large potentials in plasmas. We also work on the improvement of simulation both theoretically and practically.

20029 (ENEA-RT-FUS—86-7, pp 17-22) **On some interesting properties of the working temperature in a tokamak reactor.** Brunelli, B. (ENEA, Frascati, Italy. Centro Ricerche Energia). 1987. NTIS (US Sales Only), PC A06. Order Number DE87752631/JAW. (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

A D, T burning plasma has two equilbrium temperatures T/sub 1/ and T/sub 2/ wherein power-in equals power-out. At marginal ignition: T/sub 2/=T/sub 1/=T/sub 0/. It will be shown that, under hypothesis usually satisfied in a Tokamak reactor, the temperature T/sub 0/ has a peculiar behaviour with respect to the reactor parameters. Simple expressions are given for T/sub 0/, T/sub 1/ and T/sub 2/ which have been found quite straightforward for a well-grounded discussion of the thermal reactor dynamics. Typical cases of interest are discussed.

20030 **(ENEA-RT-TIB—86-68) Thomson scattering experiment pulsed by CO/sub 2/ laser in FT.** Bartolini, L.; Fornetti, G.; Nardi, M.; Occhionero, G.; Ferri de Collibus, M. (ENEA, Frascati, Italy. Centro Ricerche Energia). (ENEA, Rome (Italy)). 1987. 58p. (In Italian). NTIS (US Sales Only), PC A04/MF A01. Order Number TI88701421/JAW.

An experiment carried out to measure the plasma ion temperature Tsub(i) in the tokamak FT in Frascati by Collective Thomson Scattering. A tandem laser system generates two single mode beams (10.6μ) one of which is pulsed and amplified up to levels of 5 MW, 1μs and actively frequency locked to a second continuous wave low pressure CO/sub 2/ laser. The pulse beam crosses the plasma and the forward scattered light is collected at angles between 1 degrees centigrade and 1.6 degrees centigrade. An heterodyne technique in which the c.w. beam is the local oscillator is used to measure the Doppler enlarged spectral density of the signal. The experimental apparatus is described and the results are reported and discussed. 22 refs.

20031 **(GA-A—18834) Reversed field pinch operation with a thin shell.** Ortolani, S.; Antoni, V.; Martini, S.; LaHaye, R.; Schaffer, M.; Tamano, T.; Taylor, P. (GA Technologies, Inc., San Diego, CA (USA); Consiglio Nazionale delle Ricerche, Padua (Italy). Ist. Gas Ionizzati). Dec 1987. Contract FG03-86ER53228. 8p. (CONF-870629—14). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005521/JAW.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

This paper discusses the possible use of a thin conducting shell to achieve accurate active plasma position control. This is important for minimizing plasma-wall interactions. 7 refs., 4 figs. (LSP)

20032 **(GA-A—19056) A high field launch for electron cyclotron heating using an external window.** Moeller, C.P.; Prater, R.; Riviere, A.C.; Ainsworth, N.R.G.; Dellis, A.N.; Johnson, P.C. (GA Technologies, Inc., San Diego, CA (USA); UKAEA Culham Lab., Abingdon). Sep 1987. Contract AC03-84ER51044. 9p. (CONF-8709157—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005350/JAW.

From Joint workshop on electron cyclotron emission and the electron cyclotron resonance heating; Oxford, UK (16 Sep 1987).

Electron cyclotron heating experiments in which the extraordinary mode is launched from the inside (high field side) of the torus have required a vacuum window on the high field side of the resonance, with the part of the waveguide passing through the resonance layer pressurized, in order to avoid a breakdown at the resonance layer. We have installed a launcher in the DITE tokamak which tests an alternative scheme permitting an external vacuum window to be used. In this system, resonant breakdown is avoided by means of an electrostatic field, applied by means of a longitudinally split TE_{11} mode waveguide, which sweeps electrons into the waveguide wall. In tests using long pulses from a 200 kW, 60 GHz gyrotron, a field as low as 25 V/cm was found to be effective in suppressing breakdown. In the unbaked DITE vessel, it was found that in addition to an electric field, an initial glow discharge cleaning was necessary before long pulses could be transmitted. A similar approach, but with the addition of high temperature baking of the waveguide within the vacuum vessel, will be used on the DIII-D 2 MW inside launch ECH experiment. 3 refs., 4 figs.

20033 **(GA-A—19116) Confinement with electron cyclotron heating in H-mode discharges in the DIII-D tokamak.** Prater, R.; Lohr, J.M.; Luce, T.; Matsuda, K.; Moeller, C.P.; Snider, R.; Stallard, B.W. (GA Technologies, Inc., San Diego, CA (USA)). Dec 1987. Contract AC03-84ER51044. 16p. (CONF-8709157—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005520/JAW.

From Joint workshop on electron cyclotron emission and the electron cyclotron resonance heating; Oxford, UK (16 Sep 1987).

Divertor discharges in the DIII-D tokamak exhibit the characteristics of the H-mode, including improved confinement of particles and energy, when electron cyclotron heating is added at a power level above 0.75 MW. The energy confinement time in the ECH H-mode with 0.9 MW of power is about the same as that in ohmic discharges, and 2 to 3 times higher than that observed during the L-mode phase of the discharge. The H-mode generated with 1.8 MW of neutral injection under very similar experimental conditions also has energy confinement about 2.5 times that of the L-mode scaling evaluated at the higher heating power. In both cases, there is a strong correlation of energy confinement degradation with measured levels of magnetic fluctuations. 13 refs., 6 figs.

20034 (IA—1427, pp 41) **Radial temperature profile in confined high pressure discharges.** Loeb, A. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

20035 (IA—1427, pp 46) **Experimental measurements of the characteristics of a free plasma jet, using spectrometric observations.** Spector, N.; Levinson, J.; Brill, B.; Gerasi, Y.; Kimchi, D.; Loeb, A.; Kaplan, Z. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

20036 **(IAE—4226/7) Study of radiative losses of plasma in electron-cyclotron, ion-cyclotron and injection heating at the T-10 and T-11 devices.** Borshchegovskij, A.A.; Vertiporokh, A.N.; Vdovin, V.L.; Vodo, A.N.; Longinov, A.V.; Maksimov, Yu.S.; Miroshnichenko, G.A.; Chmyga, A.A.; Shapotkovskij, N.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 16p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703192/JAW.

The results of experiments performed at the T-10 and T-11 devices on intense heating of a plasma using electron-cyclotron (EC), ion-cyclotron (IC) resonances and neutral injection are presented. The role of radiative losses in energy balance of a plasma is considered. Possible mechanisms of impurities intake are indicated. The optimization heating parameters for attaining maximum heating efficiency are given. Experiments have shown that the linear dependence between increment in radiative losses and auxilliary power introduced in plasma is conserved. The proportionality coefficient in the experiments constituted $K \approx 0.15$ at ECR heating, $K \approx 0.4$ at injection heating and $K \approx 0.8$ at ICR heating. 16 references, 14 figures.

20037 (IAEA-TECDOC—441, pp 27-41) **Non-inductive current drive. Summary and conclusions.** Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

The main task of this meeting was to compare the experimental results available with the theoretical models developed in the field of non-inductive current drive in tokamak plasmas. The following schemes for non-inductive drive have been discussed: lower hybrid waves, fast magnetosonic waves, electron cyclotron waves, Alfven waves and neutral beams. All aspects of non-inductive current drive have been considered, i.e. steady-state current drive, electric field effects (including transformer recharging and current ramp-up) and, current initiation.

20038 (IAEA-TECDOC—441, pp 52) **Extrapolation of neutral beam current drive to next step devices.** Cox, M. (Commission of the European Communities, Abingdon, UK. JET Joint Undertaking). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

20039 (IAEA-TECDOC—441, pp 53) **Driven currents during beam heating on TFTR.** Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

During recent operation TFTR has achieved injected neutral beam power of as much as about 18 MW. With a well conditioned limiter and low initial densities, we have observed enhancements in the energy confinement time of twice and as much as three times those predicted by Goldston Low-Mode scaling, and we have reached maximum beta poloidals of about 2. With co-injection only and with counter-injection only, we have seen signs of beam driven current in qualitative agreement with the expectations of neoclassical theory. With balanced and near-balanced beam injection we see signs of significant driven currents. Preliminary analyses of these currents indicate that they are consistent with the predictions of neoclassical bootstrap theory.

20040 (IAEA-TECDOC—441, pp 54-55) **Preliminary analysis of the JET experiments on current drive by neutral beam injection and its future potential.** Cordey, J.G.; Challis, C.; Hamnen, H.; Muir, D.; Stork, D.; Thompson, E. (Commission of the European Communities, Abingdon, UK. JET Joint Undertaking). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

20041 (IAEA-TECDOC—441, pp 56) **Computer simulation of the current initiation of the RF tokamak.** Maekawa, T. (Kyoto Univ., Japan). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

By injecting the LH wave into the microwave discharge plasma at the electron cyclotron (EC) resonance in WT-2, the plasma current is generated, started up to Ip=9 kA, and sustained by RF power alone, without OH power (RF tokamak). In order to understand the physical mechanism of current initiation process of the RF tokamak, two dimensional Fokker-Planck equation, which includes quasilinear diffusion terms of EC wave and LH wave, particle and energy losses, is solved computationally. The calculations show the following results: In the initial EC heated plasma, the applied vertical field Bv cancels the toroidal drift for some electrons, that is electron confinement is asymmetric along the toroidal direction. Thus, net current is generated to produce the poloidal field and the electrons are confined in an equilibrium position. The dependence of generated currents on Bv qualitatively agrees with experimental results. Further, the electrons, which are accelerated in the perpendicular direction by the EC wave, are pitch-angle scattered by Coulomb collision to the parallel direction and quasilinearly interact with the LH wave having high phase velocity, resulting in a toroidal current start-up.

20042 (IAEA-TECDOC—441, pp 57) **Verification of theories with ASDEX LHCD data.** Yoshioka, K.; Okazaki, T.; Matsuura, H.; Yamamoto, T.; Sugihara, M.; Fujisawa, N. (Hitachi Ltd, Ibaraki, Japan; Kyushu Univ., Fukuoka, Japan; Japan Atomic Energy Research Inst., Ibaraki, Japan). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

Two models are compared with ASDEX LH current drive experimental data under the presence of DC electric field. The first model is a numerical code in which the radial dependence of rf power spectrum is analyzed on the basis of 1-D Fokker Planck equation. The second model is an analytical one in which the adjoint equation to the 2-D Fokker Planck equation is analytically solved and the figure of merit J/sub N//P/sub N/ is derived considering the finite spread of wave power spectrum in n-para space. Prior to the analysis of experimental data, the launcher wave spectrum has been modified to take account of the so-called spectrum gap, such that the steady state (Eparallel =0) rf driven current coincides with that of experiment (Ip=300 kA). The resulting spectrum extends from nparallel =1.5 to 6.0. Consequently, the values of J/sub N//P/sub N/ predicted by both models at Eparallel =0 agree with experimental value within the factor of 0.8. The dependence of J/sub N//P/sub N/ on Eparallel predicted by 1-D code fails to coincide with that of experiment, whereas the second model based on the adjoint method correctly predicts the experimental tendency in the low density regime (n/sub e/ <= 1.5 x 10/sup 13/ cm/sup 3/).

20043 (IAEA-TECDOC—441, pp 58-59) **RF current ramp-up and comparisons with experiments.** Karney, C.F.F. (Princeton Univ., NJ, USA. Plasma Physics Lab.). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

20044 (IAEA-TECDOC—441, pp 60) **Plasma current ramp-up and OH recharging experiments at high densities on Alcator C.** Takase, Y.; Knowlton, S.; Porkolab, M. (Massachusetts Inst. of Tech., Cambridge, USA). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

20045 (IAEA-TECDOC—441, pp 61-62) **Numerical studies of lower hybrid current ramp-up in Alcator C.** Bonoli, P.; Takase, Y.; Knowlton, S.; Porkolab, M. (Massachusetts Inst. of Tech., Cambridge, USA). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

20046 (IAEA-TECDOC—441, pp 63-64) **Lower hybrid current drive in PETULA: Parametric dependences and trends.** Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

20047 (IAEA-TECDOC—441, pp 65-66) **Lower hybrid current drive on ASDEX: Experiments and modelling.** Leuterer, F. (Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

20048 (IAEA-TECDOC—441, pp 67-68) **Efficiency of voltsecond saving in combined OH/LH-current drive.** Soeldner, F. (Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

20049 (IAEA-TECDOC—441, pp 69) **Computation of ramp-up efficiency in lower hybrid current drive.** Chan, V.S. (GA Technologies, Inc., San Diego, CA, USA). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

20050 (IAEA-TECDOC—441, pp 70-71) **Current drive simulations.** De Barbieri, O.; Nocentini, A. (Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

20051 (IAEA-TECDOC—441, pp 72-73) **Power deposition profile in LH heated or driven plasmas.** Barbato, E.; Zanza, V. (Associazione Euratom-ENEA sulla Fusione, Centro Ricerche Energia Frascati, Italy). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

20052 (IAEA-TECDOC—441, pp 74-75) **Non-linear picture of LH waves and its implications for the experiments.** Canobbio, E.; Croci, R. (Association Euratom-Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

20053 (IAEA-TECDOC—441, pp 76) **Two-dimensional quasi-linear modelling of lower-hybrid current ramp up.** Succi, S.; Appert, K.; Vaclavik, J. (European Centre for Scientific and Engineering Computing, IBM/ECSEC, Rome, Italy; Centre de Recherches en Physique des Plasmas, Lausanne, Switzerland). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

20054 (IAEA-TECDOC—441, pp 77) **Fast wave current drive experiment on the JFT-2M tokamak.** Yamamoto, T. (Japan Atomic Energy Research Inst., Ibaraki). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

First, a 200 MHz fast wave (FW) experiment for the JFT-2M tokamak is examined theoretically. Noticeable single-path electron Landau damping of the FW with the parallel refractive index of Nparallel =4 is expected in the plasma with electron temperature more than 2.5 keV at the electron density of n/sub e/=1.5 x 10/sup 19/m/sup -3/. In addition, it is predicted that an 8 kA of the plasma current is driven by the FW with Nparallel =2 at n/sub e/=3 x 10/sup 19/m/sup -3/ in single-path damping when 100 kW of the rf power radiates into the plasma in the presence of hot electrons with the temperature of 19 keV and the fraction of the density of 2%. Next, initial results on the FW experiment with 80 kW of the RF power are reported. A phased loop antenna array is employed to launch the FW into a plasma in which the wave frequency is of the order of 10f/sub ci/. A high loading resistance of about 5 Ω is obtained and its value agrees well with the theoretical estimation. The loading efficiency of about 80% is obtained. For n-bar/sub e/<2 x 10/sup 18/, the current drive is observed. The density limit is also observed and correlates with the excitation of parametric instabilities. These results are similar to those of LHCD with the frequency of 0.75 GHz except a critical density.

20055 (IAEA-TECDOC—441, pp 78-80) **Fast wave current drive: Experimental regimes and potential for profile control in large tokamaks.** Moreau, D.; O'Brien, M.R.; Cox, M.; Start, D.F.H. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance, France; Commission of the European Communities, Abingdon, UK. JET Joint Undertaking). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

20056 (IAEA-TECDOC—441, pp 81-82) **Status of electron cyclotron current drive/comparison of the theory with experiments.** Start, D.F.H.; O'Brien, M.R.; Dendy, R.O. (Commission of the European Communities, Abingdon, UK. JET Joint Undertaking). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

20057 (IAEA-TECDOC—441, pp 83) **Study of electron cyclotron current drive in lower-hybrid current driven plasma on the JFT-2M tokamak.** Yamamoto, T. (Japan Atomic Energy Research Inst., Ibaraki). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

20058 (IAEA-TECDOC—441, pp 84) **Electron cyclotron current drive efficiency in tokamaks.** Chan, V.S. (GA Technologies, Inc., San Diego, CA, USA). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

Electron cyclotron current drive efficiency in a tokamak taking into account trapped particle effects was previously considered assuming a specific model of the rf fields on a flux surface. We reconsider the problem here for a quasi-optical beam using the same approach. A closed form expression for the current drive efficiency is obtained which can easily be coupled to a ray-tracing code. This method is shown to be equivalent to the adjoint method and in the cyclinder limit, the Fisch-Boozer result is recovered. Inside launch and outside launch are compared. It is found that inside launch can eliminate most but not all of the trapped particle effects.

20059 (IAEA-TECDOC—441, pp 87-123) **Confinement in tokamaks with intense heating. Report of a specialists' meeting held in Kyoto, 21-22 November 1986.** Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-8611218—; CONF-8509441—; CONF-860995—; CONF-8606376—).

From Conference on confinement in tokamaks with intense heating; Kyoto, Japan (21 Nov 1986).

The purpose of the meeting was to review the experimental data-base on energy confinement in large tokamaks with intense additional heating and to evaluate to what extent this data-base is in agreement with the various theoretical concepts proposed. Particular attention has been paid to the following issues: importance and role of plasma profiles, including evidence for and parameter dependences of clamping of the electron temperature profile both in L- and H-mode discharges, importance and role of plasma edge conditions, importance and role of control of the MHD behaviour. Experimental data from tokamaks in the EC, Japan, USA and USSR are analysed and the implications of recent results on tokamak confinement for next-generation devices of the INTOR class are derived.

20060 (INIS-mf—11089, pp 66) **Temporal development of RF capacitively and inductively coupled plasmas.** Vender, D.; Boswell, R.W. (Australian National Univ., Canberra. Plasma Research Lab.). 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700825/JAW. (CONF-870207—).

From 16. plasma physics conference; Lucas Heights, Australia (9 Feb 1987).

20061 **(IPP—III/126) Model of H/L transition in tokamak.** Itoh, S.I.; Itoh, Kimitaka. (Hiroshima Univ., Japan. Inst. of Fusion Theory; Kyoto Univ., Uji, Japan. Plasma Physics Lab.). (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Hiroshima Univ. (Japan). Inst. for Fusion Theory; Kyoto Univ., Uji (Japan). Plasma Physics Lab.). Aug 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88752256/JAW.

New model of L/H transition in tokamak plasmas is presented. Nonambipolar particle losses determine the consistent radial electric field near plasma periphery. 'Cusp type catastrophe' among the radial electric field, particle flux and edge gradients is found. At the transition, plasma loss can take multiple values for one profile of density/temperature near the edge. Critical edge condition for transition is obtained.

20062 **(JET-R—86-05) Theory of excitation of asymmetric ksub(longitudinal)-spectrum by phasing the JET ICRF antennae.** Bhatnagar, V.P.; Evrard, M.P.; Jacquinot, J. (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). 1986. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750901/JAW.

A theoretical study is presented of the excitation of travelling ICRF waves in JET, based on a 3-D planar antenna-plasma coupling model. The antennae are progressively phased to excite a desired integral number of parallel wavelengths around the torus (n_0 = 1, 2, 3 ... etc) where n_0 = 3 or 4 is appropriate for mode conversion current drive and a somewhat higher number for the minority current drive. Several sets of antenna combinations including that of a single pair alone have been analyzed and it is found that a single pair of antenna system is unable to impose the desired n_0 in the plasma. However, as the number of energized antennae is increased, the directivity increases reaching about 20% for 8 antennae and the imposed n_0 is alsb found inside the plasma. Also presented are results of the field distribution in real space inside the plasma by Fourier inversion of the ksub(longitudinal)-spectrum radiated by the travelling wave antennae.

20063 **(JET-R—86-08) Reference data for plasma shaping and magnetic separatrix formation in the JET poloidal field system.** Lazzaro, E.; Keegan, B. (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). 1986. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750902/JAW.

The analysis and the design of special equilibrium configurations (plasma with separatrix boundary) can be greatly simplified by a chart of the response of the plasma to currents in the poloidal field coils. This note presents this information for some interesting cases, namely for elongated plasmas eventually transformed into double null or in single null separatrix configurations. The calculations are made using the latest edition of the JET equilibrium code "INVERSX" including the detailed permeability characteristics of the iron core.

20064 **(LA—11175-MS) Passive equilibrium studies on ZT-P.** Pickrell, M.M.; Reass, W.A. (Los Alamos National Lab., NM (USA)). Dec 1987. Contract W-7405-ENG-36. 17p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005074/JAW.

The poloidal field system of ZT-P was modified by the addition of a transformer, which coupled the magnetizing and equilibrium circuits. ZT-P is a small, air core, Reversed Field Pinch, operated at the Los Alamos National Laboratory. It is used as test bed for the much larger ZT-H, RFP experiment, now under construction at LANL. Planned experiments include size scaling measurements and determining the effect of low time constant measurements and determining the effect of low time constant shell operation. ZT-P has had an entirely passive equilibrium system, which did not provide a well centered equilibrium, although a tolerable equilibrium was realized by removing half of the equilibrium coil set. The transformer was added to the poloidal field system to adjust the equilibrium current for a centered plasma, while using the entire coil set. It also had the effect of reducing the dependence of the equilibrium on the plasma resistance. Stable, well centered discharges were achieved over a broad range of plasma currents. The improved equilibrium also lowered the loop voltage and extended the discharge lifetime. These experiments also investigated the unique problems of equilibrium systems on air core RFP devices. 26 refs., 6 figs.

20065 **(LRP—324/87) 14th European conference on controlled fusion and plasma physics: Contributed papers.** (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Jun 1987. 17p. (CONF-870629—Exc.). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88900372/JAW.

From 14. European conference on controlled fusion and plasma physics; Madrid, Spain (22 Jun 1987).

This paper contains contributed papers from the 14th European conference on controlled fusion and plasma physics. The principle topics of these papers are alfven wave heating in the TCA tokamak, turbulent density fluctuations and broadband magnetic turbulence. Separate abstracts were prepared for the 4 papers in these proceedings. (LSP)

20066 (ORNL—6332, pp 99-169) **Plasma theory and computing.** Oct 1987. NTIS, PC A19/MF A01. Order Number DE88003651/JAW.

In Fusion Energy Division annual progress report period ending December 31, 1986.

During 1986, theorists at ORNL, working with their local experimental colleagues and with physicists at other laboratories throughout the world, made a number of key contributions. Among these were the development of equilibrium analysis methods and computer codes to analyze completely general, free-boundary, three-dimensional toroidal systems and corresponding methods and codes of similar generality for analysis of collisional plasma processes, such as transport and generation of bootstrap currents and electric fields. Other accomplishments were increased realism in simulation models and codes for analysis of rf heating fields and plasma response in devices with dimensions that do not greatly exceed the wavelengths and a new approach, using high shear to attain second stability, was developed, as was a method for testing this approach on Heliotron-E. Support was provided to several laboratories that plan tests of the flexible heliac concept. Substantial support was also provided to the national effort to design an ignited plasma experiment for the early 1990s, with particular emphasis at ORNL on the physics of alpha particles and pellet injection and on analysis of fusion burn dynamics. Theoretical analysis was initiated in support of the national effort to develop a follow-on candidate for an Engineering Test Reactor. In the computing area, advanced techniques and systems for data acquisition and analysis were developed for several of the division's experimental facilities. These included ATF, the Large Coil Test Facility, the RF Test Facility, and development activities in plasma heating and fueling.

20067 (ORNL—6332, pp 341-346) **Neutron transport.** Oct 1987. NTIS, PC A19/MF A01. Order Number DE88003651/JAW.

In Fusion Energy Division annual progress report period ending December 31, 1986.

The neutron transport program includes three elements: analyses, cross-section evaluation and processing, and the work of the Radiation Shielding Information Center (RSIC). The analysis program, at present, is part of a joint US-Japan neutronics program and is directed at validating available computer codes and cross-section data by comparing calculated results with experimental data obtained from the Fusion Neutron Source (FNS) facility at the Japan Atomic Energy Research Institute (JAERI). The evaluation and processing program is directed at producing accurate cross-section data for materials that are of specific interest to fusion reactor designers. Staff members of the RSIC serve as technical consultants to the fusion energy research community, as well as a variety of other research communities, on all matters related to neutron transport.

20068 **(RAL—86-046) Annual report to the Laser Facility Committee 1986.** (Rutherford Appleton Lab., Chilton (UK)). 1986. 331p. NTIS (US Sales Only), PC A15/MF A01. Order Number DE88750850/JAW.

This paper is the annual report of the Science and Engineering Research Council, research and development work carried out

at the Central Laser Facility, Rutherford Laboratory, United Kingdom, 1985/1986. Part I contains the technical details of the studies of the High Power Laser scientific programme and Laser Support Facility, as well as the Laser Research and Development investigations. Part II concerns the application of UV lasers to microcircuit fabrication.

20069 **(UCID—17530-88-Rev.7) The computational physics program of the National MFE Computer Center.** Mirin, A.A. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 57p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE88005236/JAW.

The principal objective of the Computational Physics Group is to develop advanced numerical models for the investigation of plasma phenomena and the simulation of present and future magnetic confinement devices. Another major objective of the group is to develop efficient algorithms and programming techniques for current and future generation of supercomputers. The computational physics group is involved in several areas of fusion research. One main area is the application of Fokker-Planck/quasilinear codes to tokamaks. Another major area is the investigation of resistive magnetohydrodynamics in three dimensions, with applications to compact toroids. Another major area is the investigation of kinetic instabilities using a 3-D particle code. This work is often coupled with the task of numerically generating equilibria which model experimental devices. Ways to apply statistical closure approximations to study tokamak-edge plasma turbulence are being examined. In addition to these computational physics studies, the group has developed a number of linear systems solvers for general classes of physics problems and has been making a major effort at ascertaining how to efficiently utilize multiprocessor computers.

20070 **(UCRL—15992) Physics modeling support contract: Final report.** (TRW, Inc., Redondo Beach, CA (USA)). 30 Sep 1987. Contract W-7405-ENG-48. 170p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88004039/JAW.

This document is the final report for the Physics Modeling Support contract between TRW, Inc. and the Lawrence Livermore National Laboratory for fiscal year 1987. It consists of following projects: TIBER physics modeling and systems code development; advanced blanket modeling task; time dependent modeling; and free electron maser for TIBER II.

20071 **(UCRL—97660) First and second harmonic ECRH experience at gyrotron frequencies at LLNL.** Stallard, B. (Lawrence Livermore National Lab., CA (USA)). Nov 1987. Contract W-7405-ENG-48. 20p. (CONF-8711107—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003998/JAW.

From International conference on ECR ion sources and their applications; East Lansing, MI, USA (16 Nov 1987).

Plasma heating of electrons in both mirror machines and tokamaks, using mm wave gyrotron sources, have been carried out in many experiments in recent years. The technology for both sources and mode-preserving waveguide transmission systems is well developed at power levels of 200 kW. At LLNL electron heating at 28 GHz in the TMX-U tandem mirror has been used to create hot electrons required for a thermal barrier (potential well). TMX-U, and other devices operating at lower frequency and power (10 GHz, few kW), routinely generates electron populations with mean energies of 100 to 500 keV and densities in the low to mid 10^{11} cm^{-3} range. Radial pressure profiles vary from peaked-on-axis to hollow and are dependent on the mod-B resonance surfaces. Experiments on the axisymmetric mirror SM-1 have shown improved heating efficiency using multiple frequencies with narrow frequency separation. The importance of rf diffusion in determining electron confinement has been shown in CONSTANCE B. Fokker-Planck and particle orbit models have been useful for understanding the importance of cavity heating for creating runaway electrons, the sensitivity of hot electron production to cold plasma, the reduction of electron lifetime by rf diffusion, and the effect of multiple frequencies on heating stochasticity. Potential wells generated in plasmas with large fractions of mirror-trapped electrons have been measured in TMX-U. These offer prospects for enhanced confinement of highly stripped ions. 11 refs., 18 figs., 2 tabs.

20072 **Effects of high-power ion Bernstein waves on a tokamak plasma.** Ono, M.; Beiersdorfer, P.; Bell, R.; Bernabei, S.; Cavallo, A.; Chmyga, A.; Cohen, S.; Colestock, P.; Gammel, G.; Greene, G.J. (Princeton Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Physical Review Letters;* **60**: No. 4, 294-297(25 Jan 1988). Contract AC02-76CH03073.

Effects of high-power ion—Bernstein-wave heating on the PLT tokamak plasmas have been investigated with up to 650 Kw of rf power coupled to the plasma. A significant improvement in the deuterium particle confinement (as much as 300%) during high-power ion—Bernstein-wave heating has been observed. Associated with it, a longer injected-impurity—confinement time, reduced drift-wave turbulence activity, frequency shifts of drift-wave turbulence, and development of a large negative edge potential were observed. The ion heating efficiency, $\Delta T/sub\ i/(0)n\text{-}bar/sub\ e//P/sub\ r//sub\ f/ = 6 \times 10^{13}$ eV cm^{-3}/kW, withough high-energy tail ions, is relatively constant up to the maximum rf power.

20073 **Ion—Bernstein-wave heating and improved confinement in the Alcator C tokamak.** Moody, J.D.; Porkolab, M.; Fiore, C.L.; McDermott, F.S.; Takase, Y.; Terry, J.; Wolfe, S.M. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review Letters;* **60**: No. 4, 298-301(25 Jan 1988).

Plasma heating by directly launched ion Bernstein waves is investigated in the Alcator C tokamak at densities n-bar/sub e/ approx. >1 x 10/sup 20/ m/sup -3/. For injected rf powers P/sub rf/approx. <180 kW, bulk ion-temperature increases of $\Delta T/sub\ i/$ approx. <380 eV, as well as improvements in global particle and central impurity confinement times by a factor of 2—3, are observed. In certain regimes, the energy confinement time improves relative to the initial Ohmic value. At higher densities (n-bar/sub e/ approx. >2 x 10/sup 20/ m/sup -3/), the heating ceases to be efficient.

20074 **Pressure surface distortion by applied ion cyclotron waves and magnetic field asymmetries.** Myra, J.R.; D'Ippolito, D.A. (Science Applications International Corporation, Plasma Research Institute, 1515 Walnut Street, Boulder, Colorado 80302). *Physics of Fluids;* **31**: No. 1, 149-157(Jan 1988).

In magnetic confinement devices the pressure surfaces must obey the parallel current constraint. In a tandem mirror, nonquadrupole magnetic field components or ion cyclotron range of frequencies (ICRF) ponderomotive effects enter the parallel current equation in a nontrivial way. The extra terms cause a shift of the plasma column and/or distortion of the pressure surface shape. These effects are examined for three cases of interest: magnetic error fields due to misaligned coils, axial asymmetries in the quadrupole or solenoidal fields, and azimuthally asymmetric ponderomotive effects associated with applied ICRF waves. The ambipolar potential can compensate for asymmetries and permit lowest order isorrhopic equilibria in some cases, but if the passing density between cells is too small $(n/sub\ p//n/sub\ a/<rT/sub\ a//ePhiR/sub\ c/)$ this cannot occur and the flux surfaces of the cells disconnect.

20075 **Helicity injection with moving vacuum—plasma boundary with arbitrary flux surfaces.** Bellan, P.M. (California Institute of Technology, Pasadena, California 91125). *Physics of Fluids;* **31**: No. 1, 215-216(Jan 1988).

If a toroidal plasma has arbitrary nested magnetic flux surfaces and a moving plasma—vacuum interface, then any helicity injected by modulating the magnetic fields is simply consumed by an increase in helicity dissipation due to the modulated fields.

20076 **Comments on "Motion of an electron bunch through a plasma" [Phys. Fluids 29, 262 (1986)].** Simon, A.; Short, R.W. (Laboratory for Laser Energetics, University of Rochester, 250 East River Road, Rochester, New York 14623-1299). *Physics of Fluids;* **31**: No. 1, 217-217(Jan 1988).

Shoucri and Storey [Phys. Fluids 29, 262 (1986)] have used a Vlasov code to follow the motion of a bunch of fast electrons through an isotropic plasma. The bunch sheds a train of oscillations. It is shown that the observed wavelength of this train follows

from a calculation of the frequency of the fastest growing bump-on-tail instability mode in the bunch region.

20077 **Ion cyclotron range of frequencies heating of plasma with small impurity production.** Ohkawa, T. (to Dept. of Energy, Washington, DC). US Patent 4,710,339. 1 Dec 1987. Filed date 27 Aug 1984. vp. Patent and Trademark Office, Box 9, Washington, DC 20232.

In a plasma device having plasma including plasma ions magnetically confined by a magnetic field, wherein the plasma has a defined outer surface and is intersected by resonance surfaces of respective common ion cyclotron frequency of a predetermined species of plasma ions moving in the magnetic field, an apparatus is described for ion cyclotron range of frequencies heating of the plasma comprising: radio frequency source means, and launching means coupled to the radio frequency source means for radiating radio frequency energy at the radio frequency onto the respective resonance surface within the plasma simultaneously from locations located outside the plasma.

20078 **Assessment of eddy current effects on compression experiments in the Tokamak Fusion Test Reactor.** Wong, K.L.; Park, W. (Princeton Plasma Physics Lab., Princeton Univ., James Forrestal Campus, P.O. Box 451, Princeton, NJ 08544). *Fujitsu Scientific and Technical Journal;* **12**: No. 3, 437-443(Nov 1987). Contract AC02-76CH03073.

The eddy current induced on the Tokamak Fusion Test Reactor vacuum vessel during compression experiments is estimated based on a cylindrical model. It produces an error magnetic field that generates magnetic islands at the rational magnetic surfaces. The widths of these islands are calculated and found to have some effect on electron energy confinement. However, resistive magneto-hydrodynamic simulation results indicate that the island formation process can be slowed by plasma rotation.

20079 **Classical transport in nonaxisymmetric toroidal magnetic confinement geometries.** Bayliss, A.; Ibanez, L.F.; Hogan, J.T. (New York Univ., NY, USA; Oak Ridge National Lab., TN, USA). *Plasma Physics and Controlled Fusion;* **29**: No. 8, 957-968(Aug 1987).

A numerical implementation of the alternating dimension algorithm for Tokamaks with ripple is presented. An explicit (Euler) method is used for the convective-diffusive system. The 1-D calculation is periodically interrupted for a new (3-D) equilibrium calculation. The transport system requires a small number of 'quasi-geometrical' coefficients obtained through the Bauer-Betancourt-Garabedian code. Results are presented for the Braginskii classical transport model for the evolution of a high beta elongated Tokamak with high field ripple over the resistive skin time. The model is extended by adding the ripple-plateau coefficient for thermal diffusivity which couples the field ripple with enhanced loss at high temperature. Preliminary results are presented for the ATF torsatron searching for the pressure and rotational transform evolution to an external current source.

20080 **Computational modeling of solid liner implosions.** Clouse, C.J.; Dietz, D.; Degnan, J.H.; Frese, M.H.; Peterkin, R.E.; Alme, M.L. (Plasma Physics Branch, Air Force Weapons Lab.). pp 14 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Solid liner implosion experiments are currently underway at the Plasma Physics Branch of the Air Force Weapons Laboratory. The purpose of this paper is to present results of computational modeling performed to aid the experimental effort. The primary code used for the modeling was MACH2, a two dimensional MHD code. Two classes of problems were investigated. The first and earliest models consisted of cylindrically symmetric liners placed between parallel electrodes that were perpendicular to the liner. The most successful calculations of the second class consisted of electrodes that slope downward to the axis. The average thickness of the liner was approximately 1 mm, while the average radius and height were both approximately 4 cm. The liner was made of aluminum and, for the second class, sloped outward from top to bottom at an angle of about 11 degrees from the vertical. Implosion velocities on the order of a centimeter per microsecond were achieved through JxB forces driven by multimegamp currents through the liner. Angled liners were used in the second class because HE driven shaped charge experiments have demonstrated that conical implosions can produce axially driven liquid metal jets. The 1/r/sup 2/ dependence of the driving force make electrically driven solid liner implosions a promising alternative to HE driven shaped charge implosions.

20081 **Analytic model of an imploding Z-pinch plasma colliding inelastically with a thin-shelled cylindrical target.** Hussey, T.W. (Sandia National Labs.). pp 16 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Experiments are underway at Sandia National Laboratories to study the feasibility of using the radiation from an imploding annular gas puff Z-pinch plasma colliding with a concentric, thin-shelled, cylindrical target to supply the required energy for a photoionization-pumped, neon-like, recombination laser. It has become clear from these experiments, however, that considerable uncertainty exists as to coupling of the pulsed power to the implosion and to the state of the gas puff prior to striking the target. The authors would like to have alternative target designs to account for these variations, but it is impractical to perform detailed code calculations for a wide variety of conditions. Therefore, they attempted to develop an analytic model that accounts for some of the basic features of the stagnation, which will allow them to limit target parameter space. In this model the authors assume that a uniform-density distributed gas puff plasma collides inelastically with an infinitesimally thin shell. By integrating the momentum equation they are able to obtain target closure time, a quantity that is easily compared to experiment. In addition, they are able to find energy available as pump radiation as a function of target parameters. They find that this quantity is maximized when target mass approximately equals the gas mass times the thickness of the gas puff divided by twice the target radius. The authors also find that this quantity is a relatively weak function of shell thickness prior to stagnation, a somewhat stronger function of target mass, and a very strong function of implosion velocity.

20082 **Effects of alpha populations on tokamak ballooning stability.** Spong, D.A.; Sigmar, D.J.; Ramos, J.J.; Hastings, D.E.; Tsang, K.T.; Cooper, W.A. (Oak Ridge National Lab., TN, USA; Massachusetts Inst. of Tech., Cambridge, USA. Plasma Fusion Center; Science Applications, Inc., Boulder, CO, USA. Plasma Research Inst.; Centre de Recherches en Physique des Plasmas, Lausanne, Switzerland). *Physica Scripta;* **16**: vp(1987). (CONF-8606186—). Contract AC05-84OR21400.

From Symposium on the role of alpha particles in magnetically confined fusion plasmas; Goteborg, Sweden (24 Jun 1986).

Fusion product alpha populations can significantly influence tokamak stability due to coupling between the trapped alpha precessional drift and the kinetic ballooning mode frequency. This effect is of particular importance in parameter regimes where the alpha pressure gradient begins to constitute a sizeable fraction of the thermal plasma pressure gradient. Careful, quantitative evaluations of these effects are necessary in burning plasma devices such as the Tokamak Fusion Test Reactor and the Joint European Torus, and we have continued systematic development of such a kinetic stability model. In this model we have considered a range of different forms of the alpha distribution function and the tokamak equilibrium. Both Maxwellian and slowing-down models have been used for the alpha energy dependence while deeply trapped and, more recently, isotropic pitch angle dependences have been examined. In the latter case the drift reversal of the not so deeply trapped alphas is an important new feature not included in the deeply trapped model. The tokamak equilibrium was initially described using the nearly concentric circular flux surface model as well as more realistic analytic and numerical calculations that include the higher order poloidal harmonics of the equilibrium. An

improved analytical model gives especially close agreement with the finite β numerical equilibrium.

20083 Progress in ICRF heating technology and designs for future large tokamak heating systems. Baity, F.W.; Swain, D.W.; Hoffman, D.J.; Bryan, W.E.; Becraft, W.R.; Mayberry, M.J.; Owens, T.L.; Yugo, J.J. (Oak Ridge National Lab., TN, USA; Grumman Aircraft Engineering Corp., Bethpage, NY, USA. Research Dept.; GA Technologies, Inc., San Diego, CA, USA; McDonnell Douglas Astronautics Co., La Jolla, CA, USA; TRW Defense and Space Systems Group, Redondo Beach, CA, USA). pp 743-749 of Fusion technology 1986. 2 volumes. Proceedings of the fourteenth symposium, Avignon, France, 8-12 September 1986. Oxford, England; Pergamon Press (1986). (EUR—10936-EN; CONF-860917—). Contract AC05-84OR21400.

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

The problem of advancing the technology of heating with the ion cyclotron range of frequencies (ICRF) for successful application to ignited plasmas is being addressed at Oak Ridge National Laboratory (ORNL) with the collaboration of several laboratories in the United States and Europe. The needs of experiments such as the Compact Ignition Tokamak (CIT) have been evaluated and conceptual approaches identified. These concepts and their components are examined in the laboratory and applied to present-day machines. The status of this program is presented.

20084 (CONF-871007—72) Mechanical design aspects of the Advanced Toroidal Facility Thomson scattering diagnostic. Shipley, W.D.; Kindsfather, R.R.; Rasmussen, D.A. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02. Order Number DE88003287/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

A two-dimensional Thomson scattering system has been designed for the Advanced Toroidal Facility (ATF), a torsatron experiment at the Oak Ridge National Laboratory (ORNL). The system is a modification of the Thomson scattering system used on the Impurity Study Experiment (ISX-B) tokamak. It will provide measurements of electron temperature (T/sub e/) and density (n/sub e/) at 15 points along a vertical chord. With multiple shots, a T/sub e/ and n/sub e/ map of a toroidal cross section of ATF can be obtained. The horizontal Thomson scattering viewing port is offset by 15° toroidally from the ports through which the vertical laser beam passes. The modifications to the ISX-B Thomson scattering system are either changes required to adapt the system to the ATF device geometry or changes that result in improvements to the original system. This paper deals with the mechanical design aspects of the laser light baffle plates that reduce the amount of extraneous light entering the plasma, the upper and lower vacuum extensions that contain the baffles and attach to the ATF vacuum vessel, the entrance window assembly, the laser dump assembly, the viewing window and shutter assembly, and the alignment target mechanism and drive used to determine the ampping of data points in the plasma cross section.

20085 (CONF-871179—3-Vugraphs) Diagnostics for ATF. Isler, R.C. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004175/JAW.

From US/Japan heliotron-stellarator workshop; Oak Ridge, TN, USA (9 Nov 1987).

This paper contains viewgraphs on diagnostic instruments used in toroidal plasmas. Ths primary instruments covered are Langmuir probe, bolometers, infrared interferometer, spectrometers, Thomson scattering systems, neutral particle analyzers and infrared cameras. (LSP)

20086 (DOE/ER/53211—123) Advanced development of particle beam probe diagnostic systems: Technical progress report covering the period October 1, 1985-August 31, 1987. Hickok, R.L.; Jennings, W.C.; Connor, K.A.; Crowley, T.P. (Rensselaer Polytechnic Inst., Troy, NY (USA)). Nov 1987. Contract FG02-85ER53211. 14p. (RPDL—87-9). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004084/JAW.

The primary emphasis during this time period was on documenting and improving fluctuation measurements with the heavy ion beam probe, improving the instrumentation and hardware and evaluating the requirements for scaling beam probes to reactor size confinement devices. All of the work has been reported in periodic progress reports and only a brief summary will be given here. 13 refs.

20087 (ENEA-RT-FUS—87-1) Feasibility of activation techniques for neutron measurements in the NET-blanket. Bertalot, L.; Pillon, M. (ENEA, Rome (Italy)). Jul 1987. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701269/JAW.

A feasibility study has been carried out on the diagnostical possibilities offered by local activation probes of measuring the neutron fluxes, fluences and energy spectra in various locations inside the NET (Next European Tours) device. Three sets of 12 candidate materials/reactions have been selected for the first wall, outboard blanket, and outboard shield positions for irradiation within a single plasma discharge.

20088 (ENEA-RT-FUS—87-4) Time resolved 14 MeV neutron detector for triton burn-up studies. Pillon, M. (ENEA, Rome (Italy)). Jun 1987. 11 p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751905/JAW.

A new detector system is proposed to measure time-dependent 14 MeV neutron emission due to triton burn-up in a tokamak plasma. A Monte Carlo simulation of the system shows a good efficiency and energy discrimination for this detector which can be used on large tokamaks such as JET and TFTR.

20089 (IAE—4227/7) Application of resonance fluorescence technique for helium-like carbon diagnostics on the T-10 tokamak. Moskalenko, I.V.; Shcheglov, D.A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703193/JAW.

Application of laser resonance fluorescence (LRF) technique for investigation of light element multicharged ion behaviour has been analysed. Description of radiation source using dye laser frequency doubling by means of potassium pentaborate crystal is presented. The source is aimed at optical pumping of 2^1S_1 -> 2^1P/sub 0,1,2/ transitions in helium-like carbon ion. A system of LRF diagnostics on the T-10 tokamak and measuring conditions are described. Results of experiments are presented. The experiments on CV ion detection corroborated validity of forecasts about realization of LRF technique on the T-10 tokamak. The diagnostic system displayed its serviceability under complicated experimental conditions (high vibrations near radiation source, electromagnetic inductions, humidity etc.). Application of this technique is promising due to a wide utilization of carbon and carbon base materials (carbides, for example) as structural materials for the modern thermonuclear device vacuum chamber elements. 27 references, 13 figures.

20090 (JAERI-M—87-157) Measurement of the anisotropic soft x-ray emission during radio frequency current drive on JFT-2M tokamak. Kawashima, Hisato; Hasegawa, Mitsuru; Matoba, Tohru; Uesugi, Yoshihiko; Hoshino, Katsumichi; Kawakami, Tomohide; Yamamoto, Takumi. (Japan Atomic Energy Research Inst., Tokyo). Oct 1987. 24p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751986/JAW.

The new 6 ch soft X-ray pulse height analyzer (PHA) system for measuring vertical soft X-ray emissions was installed in JFT-2M tokamak. The former single channel soft X-ray PHA

system can be measured tangential emissions. These systems are used to measure the anisotropic soft X-ray emissions on radio frequency current drive experiment. The experimental objects are as follows. 1) Lower hybrid current drive (LHCD), 2) LHCD combined with ECH, 3) relaxation oscillation generated by anomalous Doppler effects in LHCD. We discuss the behavior of the fast electrons estimated from measuring data. It is shown that the experimental results are consistent with the theoretically predictions.

20091 **(LBL—24235) A neutral-beam diagnostic for fast confined alpha particles in a burning plasma: Application on CIT [Compact Ignition Tokamak].** Schlachter, A.S.; Stearns, J.W.; Cooper, W.S. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004890/JAW.

Diagnostic methods for fast confined alpha particles are essential for a burning-plasma experiment. We review one- and two-electron-capture methods using energetic neutral beams, and provide quantitative estimates of signal level for a two-electron-capture method applicable to CIT. The best probe is a ground-state helium-atom beam because of its relatively good penetration into a CIT plasma and the large cross section for two-electron capture; it can be produced in useful quantities from HeH^+. We calculate a signal level of the order of 10^7 counts/s for 100 mA of accelerated HeH^+, which is sufficient to allow time-resolved measurements of the alpha-particle velocity distribution. Limited position information could be obtained for appropriate access port geometry. This diagnostic is feasible, and we recommend further research and development leading to implementation on CIT. 39 refs., 16 figs., 5 tabs.

20092 **(NRL-MR—6059) Ion energy diagnostics for voltage determinations in plasma-erosion-opening-switch experiments.** Young, F.C.; Neri, J.M.; Weber, B.V.; Commisso, R.J.; Stephanakis, S.J.; Renk, T.J. (Naval Research Lab., Washington, DC (USA)). 3 Dec 1987. Contract AI08-79DP40092. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004822/JAW.

A number of nuclear techniques have been developed and used to measure ion-diode voltages for plasma-erosion-opening-switch (PEOS) experiments on the Gamble II pulsed-power generator at NRL. The voltage is determined by measuring the energy of protons or deuterons from the diode. The techniques include neutron time-of-flight, neutron-intensity measurements, delayed activations, and stacked-foil activations. These diagnostics have evolved as the voltage developed in PEOS experiments have increased from less than 1 MV to more than 4 MV. Examples of these diagnostics are presented, and the extension of some of these techniques to voltages of more than 20 MV is described. 14 refs., 12 figs.

20093 (ORNL—6332, pp 63-98) **Atomic physics and plasma diagnostics development.** Oct 1987. NTIS, PC A19/MF A01. Order Number DE88003651/JAW.

In Fusion Energy Division annual progress report period ending December 31, 1986.

The atomic collisions research focuses on inelastic processes that are important for determining the energy balance and impurity transport in high-temperature plasmas and for diagnostic measurements. Recent crossed-beams experiments and theoretical efforts have concentrated on electron-impact ionization of multicharged iron ions in charge states ranging from 5 to 15. Parallel development of theoretical methods for treating ions with complex electronic structures has been crucial to this systematic effort, as well as to calculations of the dielectronic recombination process. A new merged-beams experiment has been implemented to provide charge-exchange cross-section measurements down to electron-volt relative energies, where theory has not been tested. In a related experiment, high-resolution electron spectroscopic measurements were made of electrons ejected from autoionizing states produced in double-electron-capture collisions of multiply charged ions with helium and H_2. Studies of electron ejection during the neutralization of multicharged ions at metal surfaces have also been initiated. The atomic physics group also operates the Controlled Fusion Atomic Data Center, which, with the assistance of a network of consultants, searches and categorizes publications on atomic collisions and prepares and distributes indexed bibliographies and compilations of recommended data to the fusion research community. The plasma diagnostics program concentrates on the development of advanced diagnostics for existing and future magnetic fusion experiments and relies primarily on optical and laser technology. The current emphasis is on the application of infrared lasers to the diagnostics of ignited multicomponent plasmas. A technique under development uses small-angle Thomson scattering of a pulsed CO_2 laser beam to measure the density and velocity distribution of fusion-product alpha particles.

20094 **(ORNL/TM—10436) Asymmetric double Langmuir probe for fast and automatic measurements of plasma temperature.** Uckan, T. (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004773/JAW.

We present a fast technique for determining the plasma electron temperature T/sub e/ automatically from the small signal application of the asymmetric double Langmuir probe when it is operated in the region where -1 < eV/sub a/T/sub e/ < 1. The method described here is based on simple time and rms averages of the probe current that results from a sinusoidally varying applied voltage V/sub a/. 4 refs., 2 figs.

20095 **(UCRL—97839) Measurements of optically thin electron cyclotron emission from relativistic electrons.** James, R.A.; Silver, E.; Boyd, D.; Ellis, R.F.; Jantz, S.; Lasnier, C.J.; Harvey, R.W.; Lohr, J.; Prater, R.; O'Brien, M.R. (Lawrence Livermore National Lab., CA (USA); Maryland Univ., College Park (USA); GA Technologies, Inc., San Diego, CA (USA)). Oct 1987. Contract AC03-84ER51044;W-7405-ENG-48. 14p. (CONF-8709157—2; GA-A—18980). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004713/JAW.

From Joint workshop on electron cyclotron emission and the electron cyclotron resonance heating; Oxford, UK (16 Sep 1987).

Electron cyclotron emission (ECE) from hot, relativistic electrons has been measured simulataneously at several optically thin frequencies (f/f/sub ce/ = 4.6, 7.0, and 9.6) on the Tandem Mirror Experiment-Upgrade. A method to determine the temporal evolution of the hot electron density, n/sub h/, and temperature T/sub h/ is discussed. Calculations of T/sub h/ agree with the analysis of the high energy x-ray spectra. Heating rates vary between 3 keV/ms and 13 keV/ms and temperatures over 300 keV have been reached by the end of the 50 ms discharge. The ECE analysis provides an order of magnitude improvement in time resolution over the x-ray analysis and shows that fast reductions in the diamagnetic loop signals are predominantly a loss of perpendicular energy stored by the mirror trapped hot electrons. These techniques for determining n/sub h/(t) and T/sub t/(t) will be used on the DIII-D tokamak in order to parameterize the nonthermal electron tail produced during ECH current drive experiments. A vertical view will be utilized and a fast (70 Hz) scanning Michelson interferometer will be used to measure the ECE spectrum between the 2nd and the 15th harmonic. 11 refs., 7 figs.

20096 **Contribution of the Zeeman effect to measured line profiles emitted by Alcator-C plasmas.** Benjamin, R.D.; Terry, J.L.; Moos, H.W. (Department of Physics and Astronomy, The Johns Hopkins University, Baltimore, Maryland 21218). *Physical Review* [*Section*] *A: General Physics;* 37: No. 2, 537-542(15 Jan 1988).

The measured line profiles of the Si IV $3s\ ^2S—3p\ ^2P^o$ doublet during 10-T operation on the Alcator-C tokamak show evidence of a contribution due to the Zeeman effect to these profiles. The assumption that these line profiles are single lines broadened only by instrumental effects and thermal broadening yields apparent kinetic temperatures for the two lines which differ by approximately 50%. Neither of the resulting temperatures is reasonable for Si IV under typical Alcator operating conditions and the difference between the temperatures cannot be explained by Doppler effects. Modifying the nonlinear least-squares fitting routine to include the (unresolved) components predicted by the weak-field limit of the Zeeman effect yields kinetic temperatures for these lines which are in agreement and are reasonable for the region of the plasma in which Si IV exists. Finally, a study of the Zeeman effect in O VII

shows that contributions from this process are important in determining ion temperatures from line broadening of the O VII 2s $^3S_1$—2p $^3P^o_2$ emission line in the vuv spectrum from Alcator-C plasmas.

20097 **Measurement of a potential barrier created by electron cyclotron resonance heating.** Chang, C.P.; Lieberman, M.A.; Meuth, H.; Lichtenberg, A.J. (Department of Electrical Engineering and Computer Sciences and the Electronics Research Laboratory, University of California, Berkeley, California 94720). *Physics of Fluids;* **31**: No. 1, 123-128(Jan 1988).

An electrostatic potential well and mirror-trapped hot electrons are created by high power (250 kW), short pulse (3 μsec) electron cyclotron resonance heating (ECRH) of a plasma in one magnetic mirror cell of a multiple mirror experiment. The creation and subsequent decay of the potential well is measured by an electron beam, time-of-flight diagnostic. Typically, the barrier rises to -40 V just after ECRH and decays within 100 μsec. A numerical model of the barrier evolution is developed, and the numerical results along with the experimental observations are presented. Both the numerical results and the experimental observations indicate a correlation between the degree of heating (diamagnetic loop voltage output) and the longevity of the barrier. It is shown that the decay of the barrier is determined mainly by the hot-electron escape rate and the hot-electron-neutral ionization rate, rather than by trapping of the passing ions.

20098 **Electron beam time-of-flight plasma potential diagnostic.** Archer, B.T.; Lieberman, M.A.; Meuth, H. (Department of Electrical Engineering and Computer Sciences and the Electronics Research Laboratory, University of California, Berkeley, California 94720). *Review of Scientific Instruments;* **59**: No. 1, 128-131(Jan 1988).

A time-of-flight method for measuring electrostatic potentials in plasmas using a modulated electron beam has been developed. The beam is injected along the magnetic field in a cylindrical plasma geometry. The phase of the electron beam modulation is detected using a Rogowski loop which encircles the beam and plasma, and the phase information is in turn related to the electrostatic potential. Measurements in vacuum and in plasma have been performed.

20099 **Asymmetric double Langmuir probe for fast and automatic measurements of plasma temperature.** Uckan, T. (Fusion Energy Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Review of Scientific Instruments;* **59**: No. 1, 198-199(Jan 1988). Contract AC05-84OR21400.

We present a fast technique for determining the plasma electron temperature T/sub e/ automatically from the small signal application of the asymmetric double Langmuir probe when it is operated in the region where -1<eV/sub a//T/sub e/<1. The method described here is based on simple time and rms averages of the probe current that results from a sinusoidally varying applied voltage V/sub a/.

20100 **Plasma-rotation determination from spectral intensity measurements.** Shaw, R.S. (Laboratory for Plasma and Fusion Energy Studies, University of Maryland, College Park, Maryland 20742). *Journal of the Optical Society of America A: Optics and Image Science;* **4**: No. 12, 2254-2259(Dec 1987).

A method for obtaining the radial distribution of plasma ion velocities from line-of-sight spectral intensity measurements is described. This method is applicable to optically thin plasmas possessing cylindrical or toroidal symmetry and depends only on relative intensity measurements from a number of line-of-sight views through the plasma. The Doppler effect from ordered motions is assumed to be the dominant mechanism in determining the line shape of the observed spectral lines. An analytic expression relating the intensity as a function of wavelength to the plasma emissivity and ion-flow velocity is derived for a cold plasma. By assuming a model for the velocity profile, the intensity profile may be deduced. By using data from several lines of sight through the plasma, it is possible to optimize the adjustable parameters of the assumed velocity profile.

20101 **Classical and holographic interferometry systems combined to document inertial fusion experiments.** Ankney, J.S.; Busch, G.E. (KMS Fusion, Inc., P.O. Box 1567, Ann Arbor, MI. 48106). *AIP (American Institute of Physics) Conference Proceedings;* **160**: No. 1, 661-663(25 Sep 1987). (CONF-861038—).

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

An optical system has been developed which is used to document inertial fusion experiments. It records both classical interferograms of solid hydrogen isotope layers within the hollow spherical fuel container prior to the shot and holographic interferograms of the plasma during the implosion. This optical system has the advantages of visible and UV utility, 2—4 μm resolution and a low space requirement. Both systems share a catadioptric objective lens and a refractive relay lens. The visible classical interferometric beam and the UV pulsed holographic probe follow different off-axis paths within the object cone of the lenses. To document the solid layer, the beam is diverted to a shearing cube interferometer using a lens-mirror assembly on a sliding stage. This assembly then slides out of the way which records four holographic interferograms of the plasma separated in time by 40—400 ps. The two operation modes, shearing interferometer and holographic, are serial; switching from one to the other requires only seconds.

20102 **Delayed neutron counting system for TFTR plasma neutron source strength measurements.** Saito, T.; Hendel, H.; Lemunyan, G.; Nieschmidt, E.B. (Plasma Physics Lab., Princeton Univ., Princeton, NJ 08544). pp 3 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Neutron source strength diagnostics will play an important role in the Q/sub DD/ (equivalent) ≃ 1 and Q/sub DT/ — 1 experiments of the Tokamak Fusion Reactor (TFTR), where Q = fusion power/heating power. A fission detector system and a foil activation system are now used for source strength measurements. For greater redundancy, a delayed neutron counting system for TFTR is being developed. Advantages are: (1) results are obtained almost immediately, (2) the same sample can be used repeatedly, and (3) insensitivity to radiation, electrical or magnetic backgrounds. Disadvantages are: (1) there is no time, energy, and spatial resolution, and (2) in-situ calibration is required. When fissionable material is irradiated by neutrons, the number of delayed neutrons emitted from delayed neutron precursors depends upon the fluence. Conversely, knowing the number of delayed neutrons, one can determine the fluence. The relationship between neutron fluence and integrated source strength of the plasma must be determined. The number of delayed neutron precursors depends on the neutron spectrum, irradiation time, and decay time.

20103 **Enhanced load current delivery from the SHIVA Star vacuum inductive store/plasma flow switch.** Price, D.W.; Baker, W.L.; Beason, J.D.; Degnan, J.H.; Hall, D.J.; Holmes, J.L.; Graham, J.D.; Lopez, E.A.; Seiler, S.; Turchi, P.J. (Air Force Weapons Lab., Advanced Weapons Office, Plasma Physics Branch, Kirtland AFB, NM 87117-6008). pp 14-15 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The experimental results reported here were obtained from passively integrated Rogowski coils mounted in the SHIVA Star device and B-dot located in the load and transfer regions of the device. The integrator time constant was 100 μs. Current measurements accuracy is estimated to be 5% for the Rogowski coils and 10% for B-dot probes. B-dot probes indicated peak currents of 13.5 MA at the breech and 13.0 MA at the muzzle with 650 ns 10-90% rise time. B-dot probes in the implosion region indicated a current greater than 9.4 MA inside 5.5 cm radius; at that time, the muzzle current was 10.3 MA. The 10-90% rise time was 170 ns. The innermost probe indicated 7.3 MA inside 3.2 cm; at that time, the muzzle current was 9.3 MA. The 10-90% rise time at 3.2 cm was 300 ns.

Timing anomalies suggested some azimuthal current asymmetry in the implosion region. The data indicate greater than 90% current delivery from the gun muzzle to just outside the initial position implosion foil and 70-80% current delivery from the gun muzzle to the partially imploded foil.

20104 **Radiation yield from SHIVA Star plasma flow switch driven fast liner implosions.** Degnan, J.H.; Baker, W.L.; Beason, J.D.; Clouse, C.J.; Hackett, K.E.; Hall, D.J.; Higgins, P.L.; Holmes, J.L.; Kriebel, J.B.; Price, D.W. (Air Force Weapons Lab., Advanced Weapons Office, Plasma Physics Branch, Kirtland AFB, NM 87117-6008). pp 15 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

A 2.5 Terawatt 0.5 MJ isotropic equivalent radiation yield was obtained in a SHIVA Star plasma flow switch driven fast liner implosion. The 1313 μF 80 kV discharge delivered 13 MA to a coaxial vacuum inductive store with a plasma armature. Over 9.4 MA current was plasma flow switched to the implosion load (>90% of the gun muzzle current at that time). The load wa a 5 cm radius, 2 cm tall, 200 μg/cm/sup 2/ aluminum plated Formvar cylindrical foil. The radiation pulse was measured with an array of seven X-ray diodes (XRDs). The XRDs all had aluminum photocathodes, a variety of filters and nickel mesh to reduce the incident X-ray photon flux to avoid Child-Langmuir saturation. The filters were chosen so that the authors had seven different diode response functions covering the energy range from 15 eV to about 3 keV. The filters were mounted remote (about 30 cm) from the XRDs. The anode mesh served as part of the mesh array. The distance between meshes was greater than 10 cm. Each XRD had a 5 cm diameter cathode with an aperture limited to a 2 cm diameter. The XRD anode-cathode gap was 1 cm and the bias was 5 kV. The theoretical Child-Langmuir saturation signal was 125 V with 50 Ω termination. The maximum observed signal was 75 V.

20105 **Measurements of plasma implosion driven x-ray laser target closure.** Porter, J.L.; Hussey, T.W. (Sandia National Labs.). pp 16 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—). Contract AC04-76DP00789.

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

A time-resolved, framing, x-ray pinhole camera filtered to look mainly at aluminum K-shell radiation has been fielded on the Proto II accelerator. This diagnostic has been used to study the dynamics of x-ray laser targets which are struck by an imploding argon Z-pinch plasma. Measurements have been made of the motion of a 2000A thick aluminum layer which is deposited on the outside of 2.0-4.0μm thick parylene, 3mm diameter cylindrical x-ray laser targets. One dimensional calculations suggest that the position of the aluminum layer can be correlated to the radial position of the center of mass of the target as it implodes. Consequently, from simple conservation of momentum arguments one should be able to relate the observed motion of the aluminum layer to the kinetic energy in the driving gas. The kinetic energy of the imploding gas determined using this method is compared with the observed total radiated energy.

20106 **K-shell x-ray radiation from exploding copper wire plasmas generated by BLACKJACK 5, n.** Gersten, M.; Rauch, J.; Rostoker, N.; Ware, K.; Davis, J.; Apruzese, J.; Whitney, K.; Loter, N. (Maxwell Labs., Inc., San Diego). pp 16 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Pulsed plasmas have been generated from single copper wire loads with diameters of 0.5-8.0 mils on BLACKJACK 5. The primary objective of this experiment was to determine the magnitude of copper K shell x-ray radiation (8-9 keV), the mechanism by which it is produced, and its scaling with input power and wire diameter. Radiation diagnostics included three sets of calorimeters, for time-integrated K-shell, L-shell, and total radiation; Ross-filtered PINs for hard x-rays, with a 7.7-9.0 keV difference band; flat-response filtered XRDs (1-3 keV); LiF and KAP crystal spectrographs for K- and L- shell x-rays, respectively; an xuv spectrometer; and a multi-filter, multi-image x-ray pinhole camera. Electrical diagnostics indicated good energy coupling between the pulseline and the load. With a 45 kV Marx bank charge voltage, peak power delivered to the diode was 7-9 TW, nearly double the levels observed with their standard gas jet load. Confirming the quality of the energy coupling was the total radiation yield, which was significantly higher than those typically obtained with gas jets.

20107 **Principles of plasma diagnostics.** Hutchinson, I.H. New York, NY; Cambridge University Press (1987). 448p. Cambridge University Press, 32 East 57 St., New York, NY 10022.

Principles of Plasma Diagnostics provides a detailed derivation and discussion of the plasma physics principles on which diagnostics are base, including magnetic measurements, electric probes, refractive index, radiation emission and scattering, and ionic processes. The text is based on first-principles development of the required concepts and includes examples of diagnostics in action taken from fusion research.

20108 **(CEA-CONF—9171) Cross-effect on electron-cyclotron and lower-hybrid current drive in tokamak plasmas.** Fidone, I.; Giruzzi, G.; Krivenski, V.; Mazzucato, E. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). May 1987. 5p. (CONF-870570—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751847/JAW.

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Electron cyclotron resonance current drive in a tomakak plasma in the presence of a lower hybrid tail is investigated using a 2D Fokker-Planck code. For an extraordinary mode at oblique propagation and down-shifted frequency, it is shown that the efficiency of electron cyclotron current drive becomes equal or greater than that of the lower hybrid waves and much greater than the corresponding efficiency of a Maxwellian target plasma at the same bulk temperature.

20109 **(CONF-870947—9) Implementation of a 3-D nonlinear MHD [magnetohydrodynamics] calculation on the Intel hypercube.** Lynch, V.E.; Carreras, B.A.; Drake, J.B.; Hicks, H.R.; Lawkins, W.F. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000625/JAW.

From 12. conference on the numerical simulation of plasmas; San Francisco, CA, USA (20 Sep 1987).

The optimization of numerical schemes and increasing computer capabilities in the last ten years have improved the efficiency of 3-D nonlinear resistive MHD calculations by about two to three orders of magnitude. However, we are still very limited in performing these types of calculations. Hypercubes have a large number of processors with only local memory and bidirectional links among neighbors. The Intel Hypercube at Oak Ridge has 64 processors with 0.5 megabytes of memory per processor. The multiplicity of processors opens new possibilities for the treatment of such computations. The constraint on time and resources favored the approach of using the existing RSF code which solves as an initial value problem the reduced set of MHD equations for a periodic cylindrical geometry. This code includes minimal physics and geometry, but contains the basic three dimensionality and nonlinear structure of the equations. The code solves the reduced set of MHD equations by Fourier expansion in two angular coordinates and finite differences in the radial one. Due to the continuing interest in these calculations and the likelihood that future supercomputers will take greater advantage of parallelism, the present study was initiated by the ORNL Exploratory Studies Committee and funded entirely by Laboratory Discretionary Funds. The objectives of the study were: to ascertain the suitability of MHD calculation for parallel computation, to design and implement a parallel algorithm to perform the

computations, and to evaluate the hypercube, and in particular, ORNL's Intel iPSC, for use in MHD computations. (LSP)

20110 **(CONF-870947—10) Fully implicit three-dimensional MHD [magnetohydrodynamics] stability and evolution in toroidal geometry.** Holmes, J.A.; Charlton, L.A.; Carreras, B.A.; Lynch, V.E. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000624/JAW.

From 12. conference on the numerical simulation of plasmas; San Francisco, CA, USA (20 Sep 1987).

The FAR family of computer codes has been developed at Oak Ridge National Laboratory to solve ideal and resistive, linear and nonlinear, 3-D full MHD problems in toroidal geometry. Extensive application of an incompressible version of these codes has been made to the linear stability of tokamaks and stellarators, and nonlinear studies have also been recently completed. Present work includes generalization of the physical model in several respects to incorporate the effects of compressibility, long mean free path, and thermal conductivity.

20111 **(CONF-871179—1-Vugraphs) Transport scaling in the collisionless-detrapping regime.** Crume, E.C. Jr. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 18p. NTIS, PC A03; 3; GPO Dep. Order Number DE88003916/JAW.

From US/Japan heliotron-stellarator workshop; Oak Ridge, TN, USA (9 Nov 1987).

This paper discusses the stellarator transport scalings with electric field, geometry and collision frequency. A new geometrical scaling has been found independent of helical ripple. (LSP)

20112 **(CONF-871179—8-Vugraphs) Transport analysis for ATF.** Howe, H. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003797/JAW.

From US/Japan heliotron-stellarator workshop; Oak Ridge, TN, USA (9 Nov 1987).

This paper contains viewgraphs on transport properties of the ATF Tosatron. Areas discussed are profile fitting, magnetic coordinates, power balance equations, ion temperature equation, neutral-beam heating, and Monte Carlo simuation of energy beam deposition. (LSP)

20113 **(DOE/ER/13174—T9) Asymptotic expansion and statistical description of turbulent systems.** Hagan, W.K. III. (California Univ., San Diego (USA)). 1986. Contract AC03-84ER13174. 169p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88004965/JAW.

A new approach to studying turbulent systems is presented in which an asymptotic expansion of the general dynamical equations is performed prior to the application of statistical methods for describing the evolution of the system. This approach has been applied to two specific systems: anomalous drift wave turbulence in plasmas and homogeneous, isotropic turbulence in fluids. For the plasma case, the time and length scales of the turbulent state result in the asymptotic expansion of the Vlasov/Poisson equations taking the form of nonlinear gyrokinetic theory. Questions regarding this theory and modern Hamiltonian perturbation methods are discussed and resolved. A new alternative Hamiltonian method is described. The Eulerian Direct Interaction Approximation (EDIA) is slightly reformulated and applied to the equations of nonlinear gyrokinetic theory. Using a similarity transformation technique, expressions for the thermal diffusivity are derived from the EDIA equations for various geometries, including a tokamak. In particular, the unique result for generalized geometry may be of use in evaluating fusion reactor designs and theories of anomalous thermal transport in tokamaks. Finally, a new and useful property of the EDIA is pointed out. For the fluid case, an asymptotic expansion is applied to the Navier-Stokes equation and the results lead to the speculation that such an approach may resolve the problem of predicting the Kolmogorov inertial range energy spectrum for homogeneous, isotropic turbulence. 45 refs., 3 figs.

20114 **(DOE/OR/21400—T332) Stellarator and torsatron transport coefficients in the 1/nu regime.** Beasley, C.O.; Hedrick, C.L. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003884/JAW.

This paper discusses present and previous words on transport theory for stellarators and torsatrons. A comparison of Shaing-Hokin, Hedrick modifications and Dkes transport theories are considered. (LSP)

20115 **(ENEA-RT-FUS—87-6) Calculations of total fusion power and spatial distribution of emissivity for a D-T thermal plasma. (Part II).** Batistoni, P.; Pillon, M. (ENEA, Rome (Italy)). Jul 1987. 16 p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751906/JAW.

The preliminary project of a diagnostic tool to measure the neutron emissivity profile for NET (Next European Torus), with an array of collimators, is presented. With the help of a neutron transport code, the maximum possible number of collimators, compatible with the crosstalk noise and space available in the NET 2.2.B, is determined within these constraints. An array of 17 collimators can be used, and some experimental results are simulated using a Monte Carlo code. These results are analyzed and an inversion procedure is used to obtain the emissivity profile and evaluate the total fusion power. The results show that the total fusion power can be measured within 10% for different emission profiles.

20116 **(IA—1427, pp 41) Characteristics of a quasi state in capillary discharges.** Loeb, A. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

20117 **(INIS-mf—10590, pp 519-521) Plasma sheath transition of a weakly ionized plasma with reflecting walls.** Riemann, K.-U. (Bochum Univ., Germany, F.R. Inst. fuer Theoretische Physik). Jun 1985. NTIS (US Sales Only), PC A23/MF A01. Order Number DE87701663/JAW. (CONF-850718—Vol.1).

From 17. international conference on phenomena in ionized gases; Budapest, Hungary (8 Jul 1985).

The presheath of a weakly ionized plasma is investigated, where ion kinetics is governed by symmetric charge exchange with cold neutrals. A previous kinetic theory is extended to account for the effect of ion reflection at the wall. 3 refs.

20118 **(IPP—6/266) Tokamak transport based on the Braginskii model.** Weitzner, H.; Kerner, W. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Jul 1987. 43p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752255/JAW.

The two-fluid transport model of Braginskii is applied to the case of a moderately large tokamak. By estimation of the order of magnitude of the various effects and omission of small terms a somewhat simpler reduced two-fluid Braginskii model is obtained. The model applies on a time scale of order tau/sub emi//m/sub e/, where tau/sub e/, is the electron-electron collision time, and energy confinement time is of this order. With electron and ion flow velocities no larger than is necassary to obtain the correct equilibrium currents, classical parallel viscosity becomes a dominant dissipative mechanism. The model allows for the slow evolution of equilibrium states. The equilibria, which include static, ideal magnetohydrodynamic equilibria as a special case, are described. Generally the number density, electrostatic potential, and flows are not constant on a flux surface. The procedure for determination of the slow time evolution of the equilibrium is sketched.

20119 **(JET-R—86-03) Numerical study of the dependence of an MHD equilibrium configuration on variations of p and q profiles.** Taroni, A.; Springmann, E. (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). 1986. 26p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750882/JAW.

The paper investigates the dependence of an MHD equilibrium configuration on variations of p and q profiles, using the ESCO

MHD equilibrium code. A short description of the ESCO code is given, followed by a brief review of work employing the code to determine the current density profile in a tokamak plasma from external magnetic measurements. Numerical results from use of the code applied to JET are presented and discussed.

20120 **(JET-R—86-07) Neoclassical impurity transport and observations of poloidal asymmetries in JET.** Feneberg, W.; Mast, F.K.; Martin, P.; Gottardi, N. (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). 1986. 34p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750903/JAW.

Bolometrically measured asymmetries of emissivity for some characteristic JET discharges are presented and are in good agreement with theoretical results of calculations worked out in the frame of neoclassical theory. Application of theory to the case of strong toroidal rotation as induced with neutral injection shows a sensitive dependance of the impurity transport perpendicular to the magnetic surfaces from the parameter of poloidal rotation. The main result is the existence of a classical flow reversal. Without any poloidal rotation of the background ions, a large inward flow of impurities for co- and counter-injection is always predicted, while poloidal rotation in the direction of the ion diamagnetic drift motion leads to a strong outward drift.

20121 **(Juel—2125) Calculation of poloidal rotation in the edge plasma of limiter tokamaks.** Gerhauser, H.; Claassen, H.A. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik). May 1987. 79p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE88752257/JAW.

The existing 2-d two-fluid code for computing the plasma profiles in the scrape-off layer of limiter tokamaks has been further developed to include the effect of poloidal rotation in the basic equations. This rotation is produced by radial electric fields which arise in the limiter shadow due to radial gradients in the Langmuir sheath potential in front of the limiter. As a consequence slight deviations from ambipolar motion must occur. A strong increase of rotation near the separatrix is connected with an electric current circuit closed via the limiter edge. The 2-d profiles of all relevant quantities are calculated and discussed for TEXTOR-typical parameters including also the effect of limiter recycled neutrals. The results agree well with the known experimental evidence on poloidal rotation and should be transferable to all limiter tokamaks.

20122 (RAL—86-088, pp 17-59) **Analysis of the FELIX experiments with cantilevered beams and hollow cylinders.** Turner, L.R.; Hua, T.Q.; Lee, S.-Y. (Argonne National Lab., IL, USA). Jun 1986. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88750883/JAW. (CONF-8603116—).

From 4. eddy current seminar; Chilton, UK (24 Mar 1986).

Experiments have been performed with the FELIX facility at Argonne National Laboratory to study the coupling between eddy currents and deflections and to provide data for validating eddy current computer programs. Experiments with cantilevered beams in crossed steady and decaying magnetic fields verify that coupling effects act to alleviate the large currents, deflections, and stresses predicted by uncoupled analyses. Measurements of magnetic fields induced in conducting hollow cylinders are analyzed by exponential fitting and by transfer functions. Spatial variation in the parameters of the exponential fit and in those of the one-and two-pole transfer functions suggests that several eddy current modes are acting in the cylinder test pieces.

20123 (RAL—86-088, pp 111-124) **Finite difference scheme for time dependent eddy currents in tokamaks.** Evans, J.; Grewal, J.; Smith, R. (Loughborough Univ. of Technology, UK). Jun 1986. NTIS (US Sales Only), PC A10/MF A01. Order Number DE88750883/JAW. (CONF-8603116—).

From 4. eddy current seminar; Chilton, UK (24 Mar 1986).

The paper reports a finite difference scheme for time dependent eddy currents, which result from plasma disruption, in tokamaks. The potential formulation employed in the present work is that of the T - Ω approach, and the numerical scheme is based on a finite difference solution of the potential equations in toroidal coordinates. The code is written in ALgol 68. Preliminary results using the scheme are presented.

20124 **Systematic calculations of plasma transport coefficients for the Periodic Table.** Rinker, G.A. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review [Section] A: General Physics;* **37**: No. 4, 1284-1297(15 Feb 1988).

Theoretical results are given for the ionization state, electrical conductivity, thermal conductivity, and thermoelectric coefficient for the entire Periodic Table over extreme ranges of temperature and density. A spherical average ion embedded in a uniform plasma background is used as a model to evaluate the electron densities of states, elastic scattering cross sections, and ionization states. These are then combined with one-component plasma structure factors to compute mean relaxation times and electrical resistivities according to an extended Ziman formula. The method of Lampe is used to compute thermal conductivities and thermoelectric coefficients from these values. Some experimental comparisons are made. The transport coefficients appear to be accurate for weakly and moderately correlated plasmas, but not for strongly correlated liquids or crystalline materials. The coefficients are tabulated as numerical functions of temperature and density. The tables extend in temperature from 10/sup -2/ to 10^4 eV. Density ranges depend upon atomic mass; lower limits range from 10/sup -4/ to 10/sup -2/ g/cm^3, and upper limits range from 10^5 to 10^7 g/cm^3. Indications are given of the regions of validity of the results.

20125 **Effects of electric field fluctuations on bootstrap current and resistivity in toroidal plasmas.** Shaing, K.C. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physics of Fluids;* **31**: No. 1, 8-11(Jan 1988). Contract AC05-84OR21400.

The effects of electric field fluctuations on bootstrap current and resistivity in toroidal plasmas are studied in the plateau regime. A tokamak is discussed as an example. The bootstrap current density is more sensitive to the fluctuations than the plasma resistivity because the bootstrap current density depends on the poloidal mode number of the fluctuations, while plasma resistivity depends on the parallel wave vector.

20126 **Transport scaling in the collisionless-detrapping regime in stellarators.** Crume E.C. Jr.; Shaing, K.C.; Hirshman, S.P.; van Rij, W.I. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physics of Fluids;* **31**: No. 1, 11-14(Jan 1988). Contract AC05-84OR21400.

Stellarator transport scalings with electric field, geometry, and collision frequency in the reactor-relevant collisionless-detrapping regime are determined from numerical solutions of the drift kinetic equation. A new geometrical scaling, proportional to $\epsilon^{3/2}$ rather than $\epsilon_t/\epsilon^{1/2}$ rather than ϵ_t is the inverse aspect ratio and ϵ_h is the helical ripple. With the new scaling, no reduction in energy confinement time is associated with large helical ripple, which provides design flexibility. Integral expressions for the particle and heat fluxes that are useful for transport simulations are given.

20127 **Simulations of the AFWL plasma flow switch experiments.** Buff, J.; Frese, M.H.; Peterkin, R.E. Jr.; Roderick, N.F. (Mission Research Corp., 1720 Randolph Road, SE, Albuquerque, NM 87106). pp 15 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

In a series of experiments at the Air Force Weapons Laboratory (AFWL), the SHIVA STAR fast capacitor bank, an inductive store, and a plasma flow switch have been used together to produce multimegaampere currents with submicrosecond rise times in cylindrical foil loads. The authors performed simulations of these experiments using their new 2-dimensional MHD computer code, MACH2, which was developed for problems with complex geometry. Briefly, it is an implicit continuous Eulerian arbitrary Lagran-

gian Eulerian (ICE-ALE) MHD code with physics, geometry, and boundary conditions controlled from input. Previous simulations of the "Quickfire" series of plasma flow switch experiments have been reported in the literature. The code was used to successfully explain both the experimental current probe data and the time history of the radiation diagnostics.

20128 **Some non-linear effects of radio frequency waves.** Thompson, W.B. (Univ. of California, La Jolla). pp 134-162 of Twenty years of plasma physics. Mc Namara, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-840932—).

From Meeting on plasma physics; Trieste, Italy (24 Sep 1984).

In this work the author discusses applications of radio frequency to fusion in the areas of RF heating, current drive, RF confinement, and diagnostics. He also discusses the non-linear phenomena associated with frequency waves in a plasma.

20129 **(BARC—1372) Rayleigh-Taylor instability in inertial confinement fusion.** Gupta, N.K. (Bhabha Atomic Research Centre, Bombay, India. Theoretical Physics Div.). (Bhabha Atomic Research Centre, Bombay (India)). 1987. 169p. NTIS (US Sales Only), PC A08/MF A01. Order Number TI8701411/JAW.

This report summarises the main results of theoretical analysis on the problem of Rayleigh-Tylor instability in inertial confinement fusion (ICF). Work presented in this report essentially covers four basic problems. Firstly, an analytical formulation to analyse the effects of plasma density inhomogeneities on the growth of the instability in plane geometry is presented. As a result of this analysis it is concluded that, for minimizing the growth rate of the instability, it may be advantageous to use the driver laser beams of higher irradiance and an optimum wave length in an ICF experiment. Secondly, a new formulation for the analysis of the instability in curved (cylindrical and spherical) geometries is presented. A general eigenvalue equation for the growth rate of the instability which is applicable for both plane and curved geometries is derived. A comparative study is made between the plane, cylindrical and spherical geometries. Also analytical expressions for the growth rates are obtained in the cases of spherical and cylindrical shell targets and their variations with respect to the aspect ratios of the shells are discussed. Thirdly, a semi-analytical analysis of the instability where the growth rate is obtained by solving numerically a (2N-1)x(2N-1) determinantal equation is presented. The semi-analytical analysis developed is applicable for the study of the growth of the instability in the present day multi-structured spherical shell targets. Finally, a dynamic analysis of the growth of the instability for a representative spherical solid target driven by laser beams symmetrically from all the sides is carried out numerically using a computer code developed for this purpose. This study confirms analytical predictions. Further, it is observed that an approximate analytical analysis with time independent density profile gives conservative estimates for the growth rate. (Abstract Truncated)

20130 **(CONF-871105—2-Vugraphs) Comparison of analytic and full guiding center behavior at a trapped-passing interface in stellarators.** Hedrick, C.L.; Tolliver, J.S.; Cary, J.R. (Oak Ridge National Lab., TN (USA); Colorado Univ., Boulder (USA)). 1987. Contract AC05-84OR21400. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004174/JAW.

From Meeting of the Division of Plasma Physics of the American Physical Society; San Diego, CA, USA (2 Nov 1987).

The toroidal adiabatic invariant, can be used to describe both trapped and passing particle motion. Analytic expressions have also been developed to treat transitional particles, which are sometimes trapped, and sometimes passing. We have developed analytic descriptions using a non-canonical Hamiltonian formalism. Here we compare analytic approaches with solutions to the full guiding center equations of motion for a model stellarator magnetic and electric field. We also develop the analytic result directly from the equations of motion, since this clarifies some points, particularly for transitional particles.

20131 **(DOE/ER/53212—115) Stability of an RFP [reversed-field pinch] with resistive and distant boundaries.** Ho, Y.L.; Prager, S.C. (Wisconsin Univ., Madison (USA). Dept. of Physics). Nov 1987. Contract FG02-85ER53212. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004155/JAW.

The linear MHD stability of current-driven modes is evaluated for a reversed field pinch in which the plasma is bounded by a thin resistive shell which is surrounded by a vacuum region out to a radius at which a perfectly conducting wall is situated. The effects of variation of the shell resistivity and wall proximity are investigated. Growth rates of tearing modes and kink modes are calculated by analytical solution based on the modified Bessel function model for the equilibrium. Relevence to experiments is discussed. 23 refs., 18 figs., 11 tabs.

20132 **(ENEA-RT-FUS—87-3) Electric field profile in presence of sawtooth activity in a Tokamak.** Alladio, F.; Vlad, G. (ENEA, Rome (Italy)). Jun 1987. 16 p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751904/JAW.

We have solved the two coupled diffusive equations for the perturbed electron temperature and poloidal magnetic field, in the framework of the Kadomtsev model for the sawtooth activity. We find that the time averaged toroidal electric field profile is radially non-uniform. A simple formula which describes the radial behaviour of the toroidal electric field is proposed, and the effect on the power balance is presented.

20133 **(ENEA-RT-FUS—87-13) Scaling for the sawtooth period from a simple model.** Alladio, F.; Ottaviani, M.; Vlad, G. (ENEA, Rome (Italy)). Jul 1987. 14 p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751908/JAW.

A previously introduced model for sawtooth behaviour in tokamaks is solved analytically under simplifying assumptions. For ohmically heated discharges, a scaling law for the sawtooth period is derived, which shows an almost linear dependence of the period on the thermal conduction time, in good agreement with numerical solutions and with experiments.

20134 **Theory of global interchange modes in shaped tokamaks with small central shear.** Ramos, J.J. (Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review Letters;* **60**: No. 6, 523-526(8 Feb 1988).

The ideal MHD linear stability theory of arbitrary-n (including n = 1) interchange modes in shaped tokamaks with flat central rotational transform is developed. The unstable modes have very long parallel wavelength everywhere, but their perpendicular wavelength is assumed to be comparable to the plasma minor radius. It is shown that the stability condition against these radially extended modes is independent of their toroidal wave number n, and identical to the shearless limit of the $n>>1$ Mercier criterion.

20135 **Tokamak m = 1 magnetohydrodynamic calculations in toroidal geometry using a full set of nonlinear resistive magnetohydrodynamic equations.** Charlton, L.A.; Carreras, B.A.; Holmes, J.A.; Lynch, V.E. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physics of Fluids;* **31**: No. 2, 347-358(Feb 1988). Contract AC05-84OR21400.

The linear stability and nonlinear evolution of the resistive m = 1 mode in tokamaks is studied using a full set of resistive magnetohydrodynamic (MHD) equations in toroidal geometry. The modification of the linear and nonlinear properties of the mode by a combination of strong toroidal effects and low resistivity is the focus of this work. Linearly there is a transition from resistive kink to resistive tearing behavior as the aspect ratio and resistivity are reduced, and there is a corresponding modification of the nonlinear behavior, including a slowing of the island growth and development of a Rutherford regime, as the tearing regime is approached. In order to study the sensitivity of the stability and evolution to assumptions concerning the equation of state, two sets of full nonlinear resistive MHD equations (a pressure convection set and an incompressible set) are used. Both sets give more stable nonlinear be-

havior as the aspect ratio is reduced. The pressure convection set shows a transition from a Kadomtsev reconnection at large aspect ratio to a saturation at small aspect ratio. The incompressible set yields Kadomtsev reconnection for all aspect ratios, but with a significant lengthening of the reconnection time and development of a Rutherford regime at an aspect ratio approaching the transition from a resistive kink mode to a tearing mode. The pressure convection set gives an incomplete reconnection similar to that sometimes seen experimentally. The pressure convection set is, however, strictly justified only at high beta.

20136 **Raman backscattering and forward scattering thresholds in parabolic density profiles.** Estabrook, K.; Kruer, W.L.; Williams, E.A. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550). *Physics of Fluids;* **31**: No. 2, 372-374(Feb 1988). Contract W-7405-ENG-48.

The growth of stimulated Raman backscattering (RBS) and forward scattering (RFS), as a function of density and temperature in a parabolic density profile, is examined and simulation results are compared to analytic theory. This work is relevant to the burnthrough foil experiments, in which Raman scattering is explored in spatial scale lengths long enough to be relevant to high gain targets.

20137 **Nonlinear ion-temperature-gradient—driven instability in low-collisionality plasmas.** Biglari, H.; Diamond, P.H.; Terry, P.W. (Institute for Fusion Studies, University of Texas, Austin, Texas 78712-1080). *Physical Review Letters;* **60**: No. 3, 200-203(18 Jan 1988).

A novel theory for the self-consistent evolution of a nonlinear trapped-ion temperature-gradient—driven instability, based on the turbulent trapping of resonant ions in the electrostatic potential of the waves, is proposed. Threshold-dependent, non-steady-state turbulence (nonlinear instability) is shown to develop. The resulting anomalous thermal and particle transports act to reconfigure the equilibrium temperature and density profiles in such a way as to return the system towards marginality. Implications of the theory for present and future-generation fusion experiments are discussed.

20138 **Dissipative trapped particle modes in tandem mirrors.** Berk, H.L.; Chen, C.Y. (Institute for Fusion Studies, The University of Texas at Austin, Austin, Texas 78712). *Physics of Fluids;* **31**: No. 1, 137-148(Jan 1988).

The theory for the dissipative trapped particle modes is developed for a tandem mirror taking into account equilibrium rotational effects, electron temperature gradients, and an axial ambipolar potential, for a broad range of collisional parameters. The electrons are treated as a Maxwellian plasma that occupies the central cell and anchor cell regions. It is assumed that the eigenfunction is piecewise constant with abrupt transitions between the anchor and central cell regions. It is found that when $\omega/\nu/\text{sub p/approx.} > 1$, with ω the mode frequency and $\nu/\text{sub p/}$ the Pastukhov loss rate, that the energy conservation structure of the collision operator produces important changes to previously developed theories. A solution to the problem is achieved by using the solution for the lifetime of an electron in an ambipolar trap, taking into account the global energy conservation. The energy conservation structure also allows a self-consistent description of dissipative instabilities when thermal gradient and electric fields are present. At very high collision frequency, a new dispersion relation is obtained, which exhibits an axially rotational shear drive coupled to radial temperature gradients producing instability. Numerical studies are presented for some parameters, with the deviation from previous theory highlighted.

20139 **Confinement of a self-stabilized tokamak under average magnetic well conditions.** Demchenko, V.V.; Fu, G.Y.; Van Dam, J.W. (Institute for Fusion Studies, The University of Texas at Austin, Austin, Texas 78712). *Physics of Fluids;* **31**: No. 1, 213-215(Jan 1988).

It is well known that the average favorable magnetic curvature of a tokamak is stabilizing with respect to pressure-driven magnetohydrodynamic instabilities at low beta and that self-stabilization occurs at finite beta in the so-called second stability regime. Here it is self-consistently investigated how these two effects, viz., the mean magnetic well and the self-stabilization, influence the energy confinement time in a tokamak, with the use of the ballooning mode transport model proposed by Connor, Taylor, and Turner [Nucl. Fusion 24, 642 (1984)].

20140 **(CONF-871105—4-Vugraphs) Study of resistive pressure-gradient-driven turbulence.** Lee, G.S.; Garcia, L.; Carreras, B.A.; Diamond, P.H. (Oak Ridge National Lab., TN (USA); Texas Univ., Austin (USA). Inst. for Fusion Studies; Universidad Complutense de Madrid (Spain). Dept. de Fisica Teorica). 1987. Contract AC05-84OR21400. 24p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005062/JAW.

From Meeting of the Division of Plasma Physics of the American Physical Society; San Diego, CA, USA (2 Nov 1987).

Previous studies have shown the resistive pressure-gradient-driven turbulence (RPGDT) is a likely cause of observed turbulent fluctuations and anomalous transport in magnetically confined plasmas. More recent study of RPGDT found a true saturation criterion and predicted significantly larger pressure diffusivity over simple mixing-length estimate. In this study, we investigate wavenumber spectrum for more detailed characteristics of this driven turbulence and consider an electromagnetic model with electron temperature evolution to study the effect of magnetic fluctuations on thermal transport.

20141 **(DOE/ET/53088—307) WKB theory of wave tunneling for Hermitian vector systems of integral equations.** Kull, H.J.; Kashuba, R.J.; Berk, H.L. (Texas Univ., Austin (USA). Inst. for Fusion Studies). Jan 1988. Contract FG05-80ET53088. 54p. (IFSR—307). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005332/JAW.

A general theory of wave tunneling in one dimension for Hermitian vector systems of integral equations is presented. It describes mode conversion in terms of the general dielectric tensor of the medium, and without regard to specific models gives a proper account to the forward and backward nature of the waves. Energy conservation in the WKB approximation can be obtained for general linear systems by a consistent treatment of the vector polarization and by the use of modified Furry rules, which are similar to those used by Heading for second order differential equations. Operational graphical rules are developed to construct global wave solutions and to determine the direction of energy flow for spatially disconnected roots. In principle these rules could be applied to systems with arbitrary mode complexity. Coupling coefficients for wave tunneling problems with up to four interacting modes are calculated explicitly. 23 refs., 9 figs.

20142 **(IA—1427, pp 42-43) Time resolved target potential measurements in laser-target interactions.** Borowitz, J.L.; Ludmirsky, A.; Arad, B.; Eliezer, S.; Gazit, Y.; Givon, M.; Jackel, S.; Zigler, A.; Yarkoni, E.; Salzman, D. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

20143 **(IA—1427, pp 47) Magnetic wave instabilities in plasmas.** Strauss, M.; Amendt, P.; Rahman, H.U. (Israel Atomic Energy Commission, Tel Aviv; New York Univ., NY, USA. Courant Inst. of Mathematical Sciences; California Univ., Riverside, USA). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

20144 **(INIS-BR—911) Effect of compressibility on the Alfven spatial resonance heating.** Azevedo, C.A. (Universidade Federal Fluminense, Niteroi (Brazil). Inst. de Fisica). 1984. 98p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number TI88701452/JAW.

The effect of compressibility of magnetic field line on the damping rate of Alfven spatial resonance heating for a high beta plasma (Kinetic pressure/magnetic pressure) was analysed, using the ideal MHD (Magnetohydrodynamic) model in cylindrical ge-

ometry for a diffuse θ-pinch with conducting wall. The dispersion relation was obtained solving the equation of motion in the plasma and vacuum regions together with boundary conditions.

20145 (IPP—2/290) ICRF heating in the W VII-A stellarator. Cattanei, G. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Oct 1987. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88752254/JAW.

The problem of ICRF wave propagation in an inhomogeneous toroidal plasma is analysed in some detail, and rf power deposition profiles in the W VII-A stellarator plasma are numerically evaluated. The two antennas used in the W VII-A stellarator are then described and a selfconsistent evaluation of their plasma loaded impedance is given. Finally, the experimental results are analysed and an attempt is made to compare them, at least qualitatively, with the theoretical predictions, even though effective plasma heating was always overshadowed by a massive increase in radiation losses.

20146 (IPPT-IFTR—42/1984) Non-linear coherent interaction of waves and particles in collisionless plasma. Zuchowski, K. (Polska Akademia Nauk, Warsaw. Inst. Podstawowych Problemow Techniki). 1984. 21p. (In Polish). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701365/JAW.

Non-linear interaction of waves and particles in collisionless plasma and the influence of non-linearity of medium on modulation of perturbation density of particles in plasma are considered. (L.I.).

20147 (RAL—87-045) Self-modulation of large amplitude Langmuir waves. Bingham, R.; Angelis, U. de; Mori, W.; Shukla, P.K. (Rutherford Appleton Lab., Chilton (UK)). Jun 1987. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751915/JAW.

We analyse the self-modulation of large amplitude Langmuir waves due to weak relativistic corrections to the plasma frequency and also to the nonlinear coupling of the wave with ion quasimodes. It is shown that the wave is unstable to long wavelength perturbations with the instability occurring in the kinetic regime which is different to the quasi-static or hydrodynamic regimes.

20148 Covariant formalism for wave propagation applied to stimulated Raman scattering. McKinstrie, C.J.; DuBois, D.F. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **31**: No. 2, 278-287(Feb 1988).

The governing equations for stimulated Raman scattering are derived in a Lorentz frame moving with arbitrary velocity relative to the background plasma. These equations are fundamental to the study of relativistic beat-wave solitary waves, which have recently been proposed for particle acceleration by Mima et al. [Phys. Rev. Lett. 57, 1421 (1986)]. An averaged Lagrangian density is constructed for this three-wave interaction. This results in a natural definition for the action flux density four-vector of each wave and the combined stress—energy tensor. It also follows from the Lagrangian structure of the system that the Manley—Rowe relations are satisfied. The covariant formalism presented here can also be used to study wave propagation in a multicomponent plasma, in which each plasma species moves with arbitrary velocity relative to the frame of observation. As a specific example, the dispersion relation for Langmuir-wave propagation in two warm relativistic electron beams is derived for the first time.

20149 Relativistic solitary-wave solutions of the beat-wave equations. McKinstrie, C.J. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **31**: No. 2, 288-297(Feb 1988). Contract W-7405-ENG-36.

In the beat-wave accelerator [Phys. Rev. Lett. 43, 267 (1979)], a large-amplitude Langmuir wave is produced by the beating of two laser beams whose frequencies differ by approximately the plasma frequency. The relativistic equations governing this three-wave interaction are shown to admit two types of solitary-wave solutions. Temporal solitary waves propagate at speeds greater than the speed of light and carry no information. Spatial solitary waves propagate at speeds less than the speed of light and do carry information. Analytic expressions are obtained for the envelopes of these waves and for the relationship between their speed and maximum amplitude. For the limit in which the propagation speed of the solitary wave is equal to the speed of light, there is no distinction between a temporal solitary wave and a spatial solitary wave. However, it can be shown that the solitary wave is unstable in this limit. The potential of the spatial solitary waves for particle acceleration [Phys. Rev. Lett. 57, 1421 (1986)] is studied. Although the spatial solitary waves are capable of accelerating particles to high energy, for typical beat-wave parameters the laser—plasma coupling efficiency is too low for this scheme to be practical.

20150 Nonlinear evolution of longitudinal plasma waves. Pao, Y. (Courant Institute of Mathematical Sciences, New York University, New York, New York 10012). *Physics of Fluids;* **31**: No. 2, 302-310(Feb 1988).

Long-time nonlinear behavior of single-mode longitudinal plasma waves is studied on the basis of the Vlasov equation with Fokker—Planck collision terms. The resonant layer, trapped island, collisional sublayers, and X-point neighborhoods are analyzed. A nonlinear evolution equation is obtained and the wave-generated current is also evaluated.

20151 Nonlinear coupling of waves in the ion cyclotron range of frequencies to tokamak trapped electron modes. McBride, J.B. (Applied Plasma Physics and Technology Division, Science Applications International Corporation, 10260 Campus Point Drive, San Diego, California 92121). *Physics of Fluids;* **31**: No. 1, 129-136(Jan 1988).

The results of a theoretical study of nonlinear coupling of waves in the ion cyclotron range of frequencies (ICRF) to tokamak dissipative trapped electron modes (DTEM) via sidebands of the ICRF source wave are presented. These interactions can affect the stability of the DTEM spectrum and thus tokamak energy confinement. Explicit expressions are derived for the nonlinear growth rates of DTEM both for fast magnetosonic and ion Bernstein source waves. Fast wave coupling is found to be destabilizing for frequencies in the ICRF at low plasma ion beta, but can be stabilizing for wave frequencies well above the ion gyrofrequency ($\omega_0$approx. $>\omega$/sub c//sub i/β/sup -1/2//sub i/). Ion Bernstein coupling can also be stabilizing or destabilizing depending on details of the source wave. Waves with $\omega_0>\omega$/sub c//sub i/, $k_0>k$, and k_0 rho/sub i/approx. >1 appear better suited for stabilization (k_0, k are the wavenumbers of the source wave, DTEM). For example, if these conditions are met and $2k_0$/sub y/$<k$ (k_0/sub y/ is the poloidal source wavenumber), it is shown that the whole DTEM spectrum for krho/sub i/ <1 can be stabilized. Analytic expressions for the ICRF wave electric field strengths for DTEM stabilization are given.

20152 Magnetic topology, nonequilibrium, and dissipation. Parker, E.N. (Dept. of Physics and Enrico Fermi Institute, Univ. of Chicago, Chicago, IL 60637). pp 305-319 of Twenty years of plasma physics. Mc Namara, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-840932—).

From Meeting on plasma physics; Trieste, Italy (24 Sep 1984).

Static equilibrium of a magnetic field throughout a large volume of highly conducting fluid requires a degree of topological symmetry that is generally lacking in nature. The dynamical nonequilibrium of the magnetic topologies in the real world forms current sheets across which there is active reconnection of the field, dissipating the energy of the magnetic strains and reducing the fields toward simpler forms. The magnetic fields in astronomical settings are generally subject to continual straining by the convection within their parent body. The work done on the field by the convection appears in the energy of the small-scale strains, and is soon dissipated by the reconnection. The intense heating of the tenuous outer atmosphere of stars by this mechanism appears to be responsible for most of the X-ray emission of ordinary stars.

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REFER ALSO TO CITATION(S) 18997, 19746, 19747, 19754, 19979, 20011, 20013, 20015, 20016, 20022, 20025, 20028, 20037, 20081, 20101, 20103, 20104

20153 (CONF-871179—Vol.1) Proceedings of US-Japan heliotron-stellarator workshop: Volume 1. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 314p. NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE88004790/JAW.

From US/Japan heliotron-stellarator workshop; Oak Ridge, TN, USA (9 Nov 1987).

This paper is the first of four volumes on the US-Japan Heliotron-Stellarator workshop. It contains talks on the Heliotron E experiment, the compact helical system (CHS) program, the status of the ATF project, the status of the W VII-AS, the status of the TJ-II program, the ATF experimental plans, the ATF diagnostics, the compact Helical system, and the CHS experimental program and diagnostics. (LSP)

20154 (CONF-871179—Vol.2) Proceedings of US-Japan heliotron-stellarator workshop: Volume 2. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 312p. NTIS, PC A14/MF A01; 1; GPO Dep. Order Number DE88004789/JAW.

From US/Japan heliotron-stellarator workshop; Oak Ridge, TN, USA (9 Nov 1987).

This paper is the second of four volumes on the US-Japan Heliotron-Stellarator workshop. It contains talks on the following: Ripple Transport at Arbitrary Collision Frequency, Transport Scaling in the Collisionless-Detrapping Regime, Transport Analysis for Heliotron E, Transport Analysis for ATF, Simulation Analysis of Heating and Transport, Analysis of W VII-A Data, Numerical Study of Fast Ion Confinement, Benchmarks of NBI Codes for Stellarators, ECH Commissioning and Plans for ATF, and ECH and ICH Startup Analysis. (LSP)

20155 (CONF-871179—Vol.3) Proceedings of US-Japan heliotron-stellarator workshop: Volume 3. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 339p. NTIS, PC A15/MF A01; 1; GPO Dep. Order Number DE88004788/JAW.

From US/Japan heliotron-stellarator workshop; Oak Ridge, TN, USA (9 Nov 1987).

This paper is the third of four volumes on the US-Japan Heliotron-Stellarator Workshop. It contains talks on the following: Heliotron EICRF Heating Experiment; CHS Heating Systems (NBI, ECH, ICH); ICH Program for ATF; ICRF Wave Propagation; the HBQM Heliac Work; configuration studies; compact torsatron studies; low aspect ratio torsatron design; optimized small stellarator designs; configuration studies for ATF; currents in ATF; currents in ATF; computations of 3-D equilibria with islands; magnetic surface mapping studies; magnetic field alignment and mapping on ATF; divertor experiments in IMS; PMI program and wall conditioning for ATF; hard X-ray suppression on ATF; plasma rotation and potential measurement; and status of heavy ion beam probe for ATF.

20156 (CONF-871179—Vol.4) Proceedings of US-Japan heliotron-stellarator workshop: Volume 4. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 115p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88004787/JAW.

From US/Japan heliotron-stellarator workshop; Oak Ridge, TN, USA (9 Nov 1987).

This paper is the fourth of four volumes on the US-Japan Heliotron-Stellarator workshop. It contains talks on the following: Compact torsatron studies; Low aspect ratio torsatron design; Optimized small stellarator designs; Currents in ATF; Computations of 3-D equilibria with islands; and Magnetic surface mapping studies. (LSP)

20157 (CONF-8707106—4-Draft) Vertical and horizontal access configurations. Spampinato, P.T. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 50p. NTIS, PC A03/MF A01. Order Number DE88004421/JAW.

From International tokamak reactor workshop; Vienna, Austria (13 Jul 1987).

A number of configuration features and maintenance operations are influenced by the choice of whether a design is based on vertical or horizontal access for replacing reactor components. The features which are impacted most include the first wall/blanket segmentation, the poloidal field coil locations, the toroidal field coil number and size, access port size for in-vessel components, and facilities. Since either configuration can be made to work, the choice between the two is not clear cut because both have certain advantages. It is apparent that there are large cost benefits in the poloidal field coil system for ideal coil locations for high elongation plasmas and marginal savings for the INTOR case. If we assume that a new tokamak design will require a higher plasma elongation, the recommendation is to arrange the poloidal field coils in a cost-effective manner while providing reasonable midplane access for heating interfaces and test modules. If a new design study is not based on a high elongation plasma, it still appears prudent to consider this approach so that in-vessel maintenance can be accomplished without moving very massive structures such as the bulk shield. 10 refs., 29 figs., 3 tabs.

20158 (CONF-8711144—1-Vugraphs) Design sensitivities and trade offs. Reid, R.L. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003773/JAW.

From ITER design meeting; Livermore, CA, USA (17 Nov 1987).

This paper contains viewgraphs on comparisons between INTOR-like tokamak reactors. Benchmark modes and optimization modes are discussed. Cost-benefit analysis is considered. (LSP)

20159 (CONF-8711145—1-Vugraphs) Contribution to panel discussion: Potential benefits of a broad magnetic fusion R and D program. Sheffield, J. (Oak Ridge National Lab., TN (USA)). 19 Nov 1987. Contract AC05-84OR21400. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003288/JAW.

From Magnetic fusion in energy policy conference; Princeton, NJ, USA (19 Nov 1987).

This paper contains viewgraphs on the historical aspects, past benefits, and future needs of a broad magnetic fusion research program. All of the major types of magnetic confinement configurations are discussed. (LSP)

20160 (DOE/ER/53160—1) The University of Maryland spheromak fusion experiment: Final report. Antoniades, J.A.; Chin-Fatt, C.; DeSilva, A.W.; Goldenbaum, G.C.; Hess, R.A.; Shaw, R.S. (Maryland Univ., College Park (USA). Lab. for Plasma and Fusion Energy Studies). 1 Dec 1986. Contract AS05-83ER53160. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005857/JAW.

The spheromak is a magnetic plasma confinement configuration that features a simple magnetic structure free of coils that link the plasma torus. It offers the possibility of a simple and efficient confinement system for a fusion plasma. Design of the experimental apparatus occupied the first 15 months of the contract period. At the same time, computer studies of the formation of the spheromak plasma, using a two-dimensional MHD code were performed. After the first 12 months of the contract period, subcontracts were let for major components of the system, particularly for the liquid nitrogen cooled bias magnetic coils, the associated power supplies, and the capacitors for the reversal bank. When the design work was complete, the machining contract for the vacuum vessel was placed. At about this time, work on the operating system for the control computer was begun. The necessary hardware items for the data acquisition computer were decided upon and ordered at the end of the second year. The capacitor bank for the Z-directed current (I/sub z/ bank) was rebuilt from existing parts here, and construction of this bank and of the parts for the reversal bank was accomplished while the outside fabrication of other major parts was in progress. Switching hardware for the two capacitor banks was fabricated in house to reduce costs. As capacitors for the reversal bank were delivered, they were incorporated into the bank mod-

ules. A full description of the MS experimental hardware is described in this paper. 2 refs., 9 figs., 1 tab.

20161 **(DOE/ER/53252—3) Improved zero dimensional model of a reversed field pinch fusion device.** Haynes, K.E. (Pennsylvania State Univ., University Park (USA). Dept. of Engineering Science and Mechanics). 10 Dec 1987. Contract FG02-87ER53252. 78p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88005212/JAW.

A zero-dimensional model has been developed which accurately predicts conditions observed during several runs of the ZT-40M reversed field pinch fusion device at Los Alamos National Laboratory. The model is based on a physical model developed by E.H. Klevans at Penn State University. Improvements made to this model included the use of coronal non-equilibrium equations for predicting impurity effects, the inclusion of an exponentially decaying ion heating term, and the relaxation of the assumption that ion and electron densities are equal in the device. The model has been used to simulate ZT-40M in both flat-top and slowly ramped current modes. Using experimentally measured density and current evolutions, the model accurately predicts observed tau/sub E/, β/sub Θ/, T/sub e/, T/sub i/, Z/sub eff/, and radiated power. The continuing goal of this work is to predict conditions in the ZT-H device, which is under construction. 28 refs., 18 figs.

20162 **(DOE/ER/53252—4) Zero-dimensional model of a reversed field pinch fusion reactor.** Veerasingam, R. (Pennsylvania State Univ., University Park (USA). Dept. of Nuclear Engineering). Dec 1987. Contract FG02-87ER53252. 118p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005213/JAW.

A zero-dimensional model for the energy balance for electrons and ions of a Reversed Field Pinch (RFP) device has been developed. The model can be used as a tool for parametric studies and has been applied to simulate some ZT-40M experiments. In the model multiplicative coefficients C_1, C_2, C_3 and C_4 are introduced to treat anomalous resistivity, electron and ion energy confinement times and to account for the instability driven ion heating that is observed in RFP experiments. Parametric studies were performed to determine the sensitivity of the model to changes in multiplicative coefficients. A set of coefficients which can simulate a number of ZT-40M experiments have been obtained and the sensitivity of T/sub e/ and T/sub i/ to these coefficients was examined. Both flat top and ramp current waveforms were studied. The effects of different levels of impurities were also examined. The results showed that while all the three impurities used, viz., carbon, oxygen and nickel contributed to Z/sub eff/, nickel dominated the impurity radiation power. The results were then applied to study the behavior of the ZT-H device which is being built in the Confinement Physics Research Facility at the Los Alamos National Laboratory. 30 refs., 39 figs., 12 tabs.

20163 **(GA-A—19133) Doublet III annual report, October 1, 1985-September 30, 1986.** (GA Technologies, Inc., San Diego, CA (USA)). Jan 1988. Contract AC03-84ER51044. 122p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005870/JAW.

This paper discusses the commissioning, scientific progress, vessel modification, neutral beam systems and collaboration programs of the Doublet-III Fusion device. (LSP)

20164 **(IAEA-TECDOC—441) Fusion reactor critical issues. Reports of three specialists meetings on impurity control modelling held in Vienna, 16-18 September 1985, non-inductive current drive held in Garching, 15-17 September 1986, confinement in tokamaks with intense heating held in Kyoto, 21-22 November 1986, and report of a consultants meeting on demo requirements held in Yalta, 4 June 1986.** (International Atomic Energy Agency, Vienna (Austria)). Nov 1987. 162p. (CONF-8509441—; CONF-860995—; CONF-8611218—; CONF-8606376—). NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW.

From Specialists' meeting on impurity control modelling; Vienna, Austria (16 Sep 1985).

The document summarizes the results of a series of INTOR-related meetings organized by the IAEA in 1985-1986 with the following topics: Impurity control modelling, non-inductive current-drive, confinement in tokamaks with intense heating and DEMO requirements. These results are useful to the specialists involved in research on large fusion machines or in the design activity on the next generation tokamaks. Refs, figs and tabs.

20165 **(IAEA-TECDOC—441, pp 125-129) DEMO requirements. Report of a consultants' meeting held in Yalta, 4 June 1986.** Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-8606376—; CONF-8509441—; CONF-860995—; CONF-8611218—).

From Consultants meeting on demo requirements; Yalta, USSR (4 Jun 1986).

The results of an INTOR-related consultants' meeting organized by the IAEA during which both the DEMO objectives and the DEMO prerequisites were reviewed taking the present fusion programmes and their orientation into account are summarized.

20166 **(IAEA-TECDOC—441, pp 131-141) On the definition of a DEMO reactor.** Hancox, R. (Commission of the European Communities, Abingdon, UK. JET Joint Undertaking). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-8606376—; CONF-8509441—; CONF-860995—; CONF-8611218—).

From Consultants meeting on demo requirements; Yalta, USSR (4 Jun 1986).

The document summarizes the definitions of a DEMO reactor used in various studies and workshops since 1977, comparing the proposed parameters of several DEMO reactors with proposed parameters for two commercial reactors and Next Step studies INTOR and NET. The design of a DEMO reactor is illustrated by details of a recent Culham DEMO design study. 11 refs, 2 tabs.

20167 **(IAEA-TECDOC—441, pp 142-147) DEMO objectives and prerequisites.** Tone, T. (Japan Atomic Energy Research Inst., Ibaraki). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-8606376—; CONF-8509441—; CONF-860995—; CONF-8611218—).

From Consultants meeting on demo requirements; Yalta, USSR (4 Jun 1986).

DEMO objectives and prerequisites are discussed from the viewpoint of a step toward the commercialization of electricity generated from fusion energy.

20168 **(IAEA-TECDOC—441, pp 148-160) Perspective on a power demonstration tokamak reactor.** Gohar, Y.; Baker, C.; Brooks, J.; Ehst, D.; Smith, D. (Argonne National Lab., IL, USA). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-8606376—; CONF-8509441—; CONF-860995—; CONF-8611218—).

From Consultants meeting on demo requirements; Yalta, USSR (4 Jun 1986).

Technical perspectives and conceptual design of the tokamak device (DEMO) that might follow ETR/INTOR is discussed. The objectives and requirements of the DEMO are viewed as a part of a comprehensive fusion research and development program. An overview of the data base required for successful DEMO operation is summarized based on previous studies. (author). 3 refs, 2 figs, 3 tabs.

20169 **(IAEA-TECDOC—441, pp 161-162) Commercial design requirements on INTOR-type reactor.** Orlov, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-8606376—; CONF-8509441—; CONF-860995—; CONF-8611218—).

From Consultants meeting on demo requirements; Yalta, USSR (4 Jun 1986).

20170 **(JAERI-M—87-112) Conceptual design study of fusion experimental reactor (FY 86 year). Plasma current, position and shape control.** Kameari, Akihisa; Kasai, Masao; Kobayashi, Takeshi; Yamada, Masao; Fujisawa, Noboru. (Japan Atomic Energy Research Inst., Tokyo). Aug 1987. 41p. (In Japanese). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751972/JAW.

Design study of plasma current, position and shape control for Fusion Experimental Reactor (FER) during FY 1986 is reported. This report includes the followings. 1) Design procedure of plasma vertical position control in FER. 2) Vertical position control of highly elongated plasma. 3) Preliminary study of plasma current, position and shape (PCPS) control system. a. Survey of PCPS control system in JT-60 and JET. b. PCPS control system in FER. c. Modeling of PCPS control system.

20171 (ORNL—6332, pp 1-61) **Toroidal confinement experiments.** Oct 1987. NTIS, PC A19/MF A01. Order Number DE88003651/JAW.

In Fusion Energy Division annual progress report period ending December 31, 1986.

The major part of these activities has again been directed at the Advanced Toroidal Facility (ATF). The construction project has been somewhat delayed by difficulties in fabricating the vacuum vessel, but completion and first operations of the facility are expected in the summer of 1987. A major accomplishment of the construction work was a successful assembly of the helical coil system. Numerous other activities, in both hardware and physics categories, are involved in the preparations for operations, and the schedules for these are on track. In the areas of advanced projects and studies, there has been work on an eventual successor to ATF (ATF-II), an ATF-based reactor (ATR), the Spherical Torus Experiment (STX), the Compact Ignition Tokamak (CIT), and the Engineering Test Reactor (ETR/TIBER-II). The latter two are contributions to the national effort toward definition of these facilities. Other collaborations represented in this report include those on Heliotron-E (US-Japan), TFTR (ORNL-PPPL), ALT-II (US-F.R.G.-Japan), and Tore Supra (US-France). Other activities are covered in the form of abstracts.

20172 (ORNL—6332, pp 171-200) **Plasma-materials interactions.** Oct 1987. NTIS, PC A19/MF A01. Order Number DE88003651/JAW.

In Fusion Energy Division annual progress report period ending December 31, 1986.

During the past year, fabrication of the top and bottom instrumented limiters for the Advanced Toroidal Facility (ATF) has progressed. A concept for divertor configuration studies has been laid out. Edge diagnostic development was concentrated on imaging techniques with charge-coupled device (CCD) and infrared (IR) cameras to study the plasma edge configuration of ATF. Arrays of H/sub α/ detectors have been designed and fabricated for studies of particle fluxes and global confinement time. Preparations have been made for wall conditioning of the ATF. International collaborations constitute a major part of the PMI Program. The conceptual design of the Tore Supra pump limiters has progressed. A magnetics code has been adapted to model the performance of a system of modular limiters. Toroidal field ripple effects have been studied to optimize the limiter shape for heat removal and particle exhaust. A diagnostic system for the pump limiter, with emphasis on optical diagnostics, has been laid out. An array of six H/sub α/ detectors has been fabricated for the ALT-II experiment on TEXTOR. Plasma transport and neutral transport codes have been set up to model particle transport with the ALT-II pump limiter in TEXTOR. In the area of plasma-surface interactions, hydrogen retention in graphite under plasma bombardment was studied.

20173 (ORNL—6332, pp 275-316) **Fusion engineering design center.** Oct 1987. NTIS, PC A19/MF A01. Order Number DE88003651/JAW.

In Fusion Energy Division annual progress report period ending December 31, 1986.

The principal focus of the FEDC resources during 1986 was the CIT project. The baseline design established for the CIT included elements derived from the preconceptual design for the FEDC version of Ignitor. The Design Center provided the systems engineering and design integration of the CIT project and led the preparation of the cost estimate and back-up documentation. In cooperation with ORNL, the Design Center had lead responsibility for several major systems, including shielding, structure, ex-vessel remote maintenance, and vacuum pumping. Analytic support was provided in the areas of magnet structure, cooldown systems for the toroidal field and ohmic heating coils, and the poloidal field coil systems. In a collaboration with Japan, an analysis of the toroidal field coils was performed. Overall systems studies were carried out with the FEDC Tokamak Systems Code. Activities in support of the mirror fusion program were concluded with the final configuration and systems design of the MINIMARS program in mid-1986. The Design Center continued to lead the engineering activities for the International Tokamak Reactor (INTOR) program. Interest in this work increased because of the potential for an expanded international program, based on initiatives development in the US-USSR summit process. The Design Center also provides the primary point of interaction between the US and the teams working on the Next European Torus in Europe and the Japanese Fusion Engineering Reactor (FER). As part of a US-Japan exchange agreement, a staff member from the Design Center completed an assignment to work with the FER team in Japan.

20174 **(SAND—87-3130C) Repetitive pulsed power for commercial reactors.** Buttram, M.T. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 16p. (CONF-871173—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005307/JAW.

From 3. ICF system and applications colloquium; Madison, WI, USA (9 Nov 1987).

This paper presents a viable concept for ICF reactor grade light ion pulsed power, based on the Hermes III adder concept. This concept will have been tested with negative polarity within a year, and plans for positive polarity tests are being formulated. Other elements of the design, such as saturable magnetic switches seem to be reasonable extrapolations of what has been or is being done. Timing swithes are a critical concern, whether they be spark gaps or the less developed PCSS option. Other switch options are becoming available as well, options that generally can be used to generate shorter electrical pulses permitting some of the bunching requirements of the mainline designs to be relaxed. Among these options are PCSS and POS.

20175 **(UCRL—96570) Magnetic and inertial fusion status and development plans.** Correll, D.; Storm, E. (Lawrence Livermore National Lab., CA (USA)). 4 Dec 1987. Contract W-7405-ENG-48. 15p. (CONF-871204—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004405/JAW.

From 8. Miami international conference on alternative energy sources; Miami Beach, FL, USA (14 Dec 1987).

Controlled fusion, pursued by investigators in both the magnetic and inertial confinement research programs, continues to be a strong candidate as an intrinsically safe and virtually inexhaustible long-term energy source. We describe the status of magnetic and inertial confinement fusion in terms of the accomplishments made by the research programs for each concept. The improvement in plasma parameters (most frequently discussed in terms of the Tn tau product of ion temperature, T, density, n, and confinement time, tau) can be linked with the construction and operation of experimental facilities. The scientific progress exhibited by larger scale fusion experiments within the US, such as Princeton Plasma Physics Laboratory's Fusion Test Reactor for magnetic studies and Lawrence Livermore National Laboratory's Nova laser for inertial studies, has been optimized by the theoretical advances in plasma and computational physics. Both TFTR and Nova have exhibited ion temperatures in excess of 10 keV at confinement parameters of n tau near 10^{13} cm^{-3} . sec. At slightly lower temperatures (near a few keV), the value of n tau has exceeded 10^{14} cm^{-3} . sec in both devices. Near-term development plans in fusion research include experiments within the US, Europe, and Japan to improve the plasma performance to reach conditions where the rate of fusion energy production equals or exceeds the heating power incident upon the plasma. 9 refs., 7 figs.

20176 **(UCRL—96657) Understanding and accepting fusion as an alternative energy source.** Goerz, D.A. (Lawrence Livermore National Lab., CA (USA)). 10 Dec 1987. Contract W-7405-ENG-48. 15p. (CONF-871204—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004356/JAW.

From 8. Miami international conference on alternative energy sources; Miami Beach, FL, USA (14 Dec 1987).

Fusion, the process that powers our sun, has long promised to be a virtually inexhaustible source of energy for mankind. No other alternative energy source holds such bright promise, and none has ever presentd such formidable scientific and engineering challenges. Serious research efforts have continued for over 30 years in an attempt to harness and control fusion here on earth. Scientists have made considerable progress in the last decade toward achieving the conditions required for fusion power, and recent experimental results and technological progress have made the scientific feasibility of fusion a virtual certainty. With this knowledge and confidence, the emphasis can now shift toward developing power plants that are practical and economical. Although the necessary technology is not in hand today, the extension to an energy producing system in 20 years is just as attainable as was putting a man on the moon. In the next few decades, the world's population will likely double while the demand for energy will nearly quadruple. Realistic projections show that within the next generation a significant fraction of our electric power must come from alternative energy sources. Increasing environmental concerns may further accelerate this timetable in which new energy sources must be introduced. The continued development of fusion systems to help meet the energy needs of the future will require greater public understanding and support of this technology. The fusion community must do more to make the public aware of the fact that energy is a critical international issue and that fusion is a viable and necessary energy technology that will be safe and economical. 12 refs., 8 figs.

20177 **Recent progress in heavy-ion fusion in the US.** Bangerter, R.O. (Lawrence Livermore National Lab., P.O. Box 808, Livermore, CA 94550). pp 105-108 of Emerging nuclear energy systems. Velarde, G.; Minguez, E. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-860601—). Contract W-7405-ENG-48.

From 4. international conference on emerging nuclear energy systems; Madrid, Spain (30 Jun 1986).

Recent developments in accelerator physics and technology have led to lower cost estimates for a heavy-ion induction linac driver. Studies show that the cost of electricity produced using such a driver are competitive with other fusion systems at a plant capacity of 1.2 GW/sub e/ and are competitive with projected fission power costs at less than 4 GW/sub e/.

20178 **TIBER II configuration and structural design.** Doggett, J.N. (Lawrence Livermore National Lab., CA, USA). pp 1881-1885 of Fusion technology 1986. Proceedings of the fourteenth symposium, Avignon, France, 8-12 September 1986. In two volumes. Oxford, England; Pergamon Press (1986). (EUR—10936-EN; CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

The TIBER-II machine is a minimum-size steady-state tokamak with sufficient fusion power, wall flux, and fluence to be used for undertaking a nuclear test mission. Although the machine is envisioned as an engineering device, it will demonstrate reactor-relevant physics. To achieve the small size and high performance goals of TIBER II, the engineered systems must be based on aggressive assumptions. In addition, the machine must be designed for ease of maintenance to ensure reaching the fluence goal of 5 MW yr/m/sup 2/ in a design lifetime of 13 years. The discussion concentrates on the configuration and structural issues of designing a small, high-field, and high-flux device.

20179 **Overview of the Compact Ignition Tokamak.** Flanagan, C.A.; Brown, T.G.; Peng, Y.K.M.; Shannon, T.E.; Schmidt, J.A.; Bushnell, C.; Citrolo, J.; Post, D.; Montgomery, D.B.; Bromberg, L. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **52**: 133(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

In 1985, the present studies were undertaken of very compact ignition devices; these devices have a major radius in the 1.1- to 1.5-m range and a mission to achieve ignition and to sustain a plasma burn sufficient to study burning plasma behavior of the order of 3 to 5 s. It is desired that the very compact size will limit the capital costs to $300 million. Several design approaches were examined. The various devices employed various design strategies to achieve the desired compact size and performance. All concepts were compact (< 2.0-m major radius) and featured high-field, high-plasma current operation. A review for an international panel in June 1985 concluded that such compact designs appear feasible and that continued study should proceed. In early 1986, a national design team formed in the US to undertake the conceptual design of a compact ignition tokamak (CIT). The project team is directed by PPPL with the participation of many US fusion institutions. A recommended approach was selected for design in early 1986. The current schedule is for a construction project to be authorized for the period fiscal years 1988 to 1993. The project team completed a comprehensive design, cost, and schedule report in May 1986 to serve as the basis for a US government decision to proceed with the project.

20180 **Integrated pool fusion reactor concept.** Sze, D.K. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **52**: 195(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

A new fusion reactor system concept has been developed based on a pool reactor configuration. The nuclear island, including only the first wall and the superconducting magnets, is submerged under a molten Flibe pool. The Flibe will fill the space between the first wall and the superconducting magnets and will provide the necessary magnet protection. Therefore, the Flibe serves multiple functions of breeding, cooling, moderating, and shielding thus eliminating the requirement for a structural blanket, reflector, and shield. The thickness requirement of the Flibe is ~ 120 cm for superconducting magnet protection, which is acceptable. Therefore, the only structural layer remaining between the plasma chamber and the toroidal field coil is the first wall.

20181 **Water are the characteristics of an attractive reactor.** Baker, C.C. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **52**: 169-170(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

An attractive fusion reactor will be one that produces a product (e.g., electricity, fissile fuels, synthetic fuels, process heat, etc.) at a competitive cost compared to alternative means of producing that same product, and that will also produce that product with acceptable (or, hopefully, improved) safety and environmental features. The author discuss here the characteristics of an attractive reactor in the context of some type of commercial market. Noncommercial (e.g., national security) applications may not impose the same type of criteria.

20182 **MINIMARS tandem mirror reactor study.** Perkins, L.J.; Logan, B.G.; Doggett, J.N.; Devoto, R.S.; Lee, J.D.; Johnston, B.H.; Barr, W.L.; Nelson, W.D.; Lousteau, D.C.; Kulcinski, G.L. (Lawrence Livermore National Lab., CA). *Transactions of the American Nuclear Society;* **52**: 175(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

During 1985-1986, Lawrence Livermore National Lab., in partnership with the Fusion Engineering Design Center of Oak Ridge National Lab., the Univ. of Wisconsin, TRW, Grumman Aerospace Corporation, General Dynamics/Convair, Argonne National Lab., and the Canadian Fusion Fuels Technology Project, has conducted the conceptual design of MINIMARS, a small commercial tandem mirror reactor with novel octopole end plugs. With a net electric output of 600 MW(e), MINIMARS is expressly designed for short (~4- to 5-yr) construction time, factory-built modules, and a passively safe blanket and thermal cycle. In this way,

we intend to achieve a small reactor based on the tandem mirror principle that will minimize utility financial risk, thereby providing an attractive alternative to the more conventional large fusion plant designs encountered to date.

20183 **Tokamak power systems studies at ANL.** Baker, C.C.; Ehst, D.A.; Brooks, J.N.; Smith, D.L.; Sze, D.K. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **52**: 175-177(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The Tokamak Power Systems Studies (TPSS) activity was initiated by the US Dept. of Energy/Office of Fusion Energy in October 1984 with the objective of exploring and developing design concepts to improve the tokamak as a commercial reactor concept. The work in FY 1985 laid the basis for a more focused effort at Argonne National Laboratory (ANL), in FY 1986, which is summarized in this paper. Several companion papers deal with more detailed results of this year's study. The primary areas of emphasis have included the plasma engineering aspects of achieving higher β in the second stability regime with radio-frequency current drive for steady-state operation, the development of a self-pumped first-wall or limiter concept, simplified liquid-metal blankets, development of new first-wall/blanket/shield concepts, and the development of inherently safe designs.

20184 **Final version of MINIMARS: an engineering view.** Nelson, W.D.; Lousteau, D.C.; Doggett, J.N. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **52**: 179(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

A 2-yr study to describe an attractive tandem mirror reactor has recently been completed. The reactor, called MINIMARS, has met all of its mission goals. For instance, it will produce 600 MW of net electrical power at a cost of < 50 mil/kWh. It has a mass utilization of better than 100 kW/tonne. In the event of a major accident, the MINIMARS reactor will minimize the risk of a major loss in investment and will be inherently safe. The first year of the study emphasized innovative concepts and trade studies that led to good cost versus performance. The second year of the study developed the proposed concepts into an integrated point design. This paper presents a description of the MINIMARS design and its related cost. The engineering integration of this machine has been a principal activity of the Fusion Engineering Design Center (FEDC) at Oak Ridge National Lab.

20185 **Advanced Tokamak Reactors based on the Spherical Torus.** Miller, R.L.; Krakowski, R.A.; Bathke, C.G.; Copenhaver, C.; Engelhardt, A.; Seed, T.J.; Zurbin, R.M.; Schnurr, N.M. (Los Alamos National Lab., CA). *Transactions of the American Nuclear Society;* **52**: 179-180(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The proposed spherical torus (ST) approach to tokamak confinement may extrapolate the first stability regime to high betas using a low aspect ratio (1.8 < A = R/sub T//a < 2.0) and significant vertical elongation (kappa = b/a ~ 3). The advanced tokamak reactor (ATR)/ST configuration incorporates resistive coils, thin blanket/shield, double-null magnetic-divertor impurity control, and the flexibility to exploit higher mass power density for a range of power outputs. Preliminary fusion-power-core (FPC) integration (e.g., mechanical layout and assembly-and-maintenance approach) and supporting engineering studies (e.g., neutronics, divertor-chamber design, and blanket thermal hydraulics) were performed, leading to the design described here.

20186 **Fusion reactor options and alternatives for the Reversed-Field Pinch.** Miller, R.L.; Krakowski, R.A.; Hagenson, R.L. *Transactions of the American Nuclear Society;* **52**: 180-181(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

One route to improved magnetic fusion power systems places more of the task of plasma confinement on plasma self currents, which, together with high plasma beta, reduce the cost and technology requirements of the surrounding engineering structure. The reversed-field pinch (RFP) is one of these poloidal-field-dominated systems and most recently has been examined as a high-power-density fusion power plant. The compact RFP reactor design has illuminated both advantages and problems associated with this particular [1000 MW(e)(net), 900 kW(e)/tonne, 20 MW/m^2(neutrons)] resistive coil reactor embodiment. As part of the continuing reassessment of the RFP approach to fusion power, a comprehensive engineering systems model has been used to examine a wide range of RFP physics, engineering, and operational issues that remain less than clear for both RFPs and fusion in general.

20187 **Common views of potentially attractive fusion concepts.** Piet, S.J. *Transactions of the American Nuclear Society;* **52**: 199-200(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Several innovative fusion concepts have recently been proposed with the intent of improving radically the attractiveness of fusion energy. Before their assessment is complete, however, the question of what constitutes an especially attractive fusion product should be examined from multiple viewpoints. The primary purpose of this paper is to examine views of potentially attractive fusion concepts from three perspectives, trying to determine commonalities. These viewpoints are (a) economics, (b) maintenance and reliability, and (c) safety and environment. The secondary purpose of the paper is to review some innovative concepts from these viewpoints.

20188 **Technical requirements of experiments and facilities for fusion nuclear technology.** Abdou, M.A.; Gierszewski, P.J.; Tillack, M.S.; Grover, J.; Puigh, R.; Sze, D.K.; Berwald, D. *Transactions of the American Nuclear Society;* **52**: 236-237(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

A process has been developed and applied to the technical planning of experiments and facilities for fusion nuclear technology. The process involves: (1) characterization of issues; (2) quantification of testing requirements; (3) evaluation of facilities; and (4) development of a test plant to identify the role, timing, characteristics, and costs of major experiments and facilities. The nuclear subsystems addressed are: (1) blanket, including the first wall; (b) radiation shield; (c) tritium processing system; and (d) plasma interactive components. Particular emphasis has been placed on the complex technical issues and development problems of the blanket.

20189 **TIBER II: an upgraded tokamak ignition/burn experimental reactor.** Henning, C.D.; Logan, B.G.; Barr, W.L.; Bulmer, R.H.; Doggett, J.N.; Fenstermacher, M.E.; Johnston, B.M.; Lee, J.D.; Miller, J.R.; Slack, D.S. (Lawrence Livermore National Lab., CA). *Transactions of the American Nuclear Society;* **52**: 237-238(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The TIBER concept has been upgraded to TIBER II, in which the more conservative Kaye-Goldstone confinement scaling is assumed in concert with recent Tokamak Fusion Test Reactor and JFT results. Also, a double-poloidal divertor is added to control impurities as in the Joint European Torus, and further current-drive options are considered, including electron cyclotron heating (ECH), lower hybrid, and negative-ion beams. These revisions along with a desire for tritium self-sufficiency have caused the major radius of the tokamak to grow from 2.6 to 3.0 m. A crescent plasma shape (kappa = 2, δ = 0.5) with a slight indentation leads to an operating beta of 9%, which is half of the critical beta in the first stability regime. The plasma current is a high 15 MA. Accordingly, ECH that is also capable of stabilizing disruptions by localized heating and current derive at the q = 2 surface (as in the T-10 experiment) is very desirable.

20190 **Fusion applications study: FAME.** Schultz, K.R. (GA Technologies, Inc., San Diego, CA). *Transactions of the American Nuclear Society;* **52**: 266(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Fusion has a wide spectrum of applications that appear technically possible and may become economically feasible. Near-term (~ 2000) application for production of nuclear fuels and useful radioisotopes is an economically attractive possibility as soon as fusion is ready. Electricity production will remain a prime, large-scale application of fusion. In the longer term, as fossil fuels dwindle, production of hydrogen could become a major application. Additional applications some of which have not even been conceived of yet, will add to this potential richness and diversity of fusion. It is the purpose of the fusion applications study - FMAE - to innovate, investigate, and evaluate these potential applications.

20191 **Radioisotope production in fusion reactors.** Engholm, B.A.; Cheng, E.T.; Schultz, K.R. (GA Technologies, Inc., San Diego, CA). *Transactions of the American Nuclear Society;* **52**: 266-267(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The fusion reaction produces energy and copious quantities of neutrons. The primary application considered for fusion has been production of central station electricity, but many other useful applications appear possible. Under subcontract with Lawrence Livermore National Lab., GA Technologies Inc. is conducting an investigation into alternative applications of fusion energy. This paper addresses one such alternative application - the production of useful radioisotopes in fusion reactors. Production of radioisotopes for a wide variety of uses will continue to be an important, growing application of nuclear energy. Fusion reactors will be able to play an important role in the production of these radioisotopes.

20192 **Deuterium-driven D-T fusion reactor test facility.** Woo, J.T.; Shuy, G.W.; Price, R.E. *Transactions of the American Nuclear Society;* **52**: 287-288(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The authors propose an alternative approach to a test facility that eliminates both the need for tritium purchase and allows full testing of the system components as an attractive route for the development of fusion power. The approach is a staged transition in a single engineering test facility from driven deuterium-deuterium (D-D) to full D-T operations. The basic idea is to use the D-D fusion reaction to generate tritium in situ for the D-T reactions to occur at levels comparable to a thermonuclear D-T plasma. The neutrons generated in the process can then be used for material and system testing and for development of effective breeding blankets. The concept differs from fully catalyzed D-D reactors in that it is to be optimized for neutron wall loading rather than power balance. Therefore, the confinement requirements are significantly more relaxes. On the other hand it is possible to attain significant neutron wall loading. There are several advantages associated with this alternative scenario for developing D-T fusion power. First and foremost, it totally eliminates the uncertainty and cost associated with assuring the availability of tritium. Secondly, the approach does not prematurely commit the development of fusion power to a specific confinement configuration. Third, the performance of the device can be continuously upgraded to meet the requirements for more critical testing, thereby compressing the time schedule needed for developing the necessary data.

20193 **Analytical study of power grid pulsing.** Bronner, G. (Princeton Plasma Physics Lab., NJ). *Transactions of the American Nuclear Society;* **52**: 288(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The next generation of fusion devices presents a number of technical challenges. Not the least of these technical issues may be the required power consumption needed to establish the experimental conditions. The influence of 500-MW or larger power pulses extends beyond the local utility to the common (national) power grid. This paper describes the development of a generic power grid model for the purpose of finding the appropriate locations on the nation's map to accommodate the substantial pulse loads of the fusion projects. The pulse load of this research differs from the conventional load (routinely experienced by the utilities) by the magnitude, rate of rise, and likelihood of load-shedding. The sequence of steps by which the power grid accommodates the impact of the load includes: (a) a change in kinetic energy, (b) a change in effective load, and (c) an increase in power generation.

20194 **Evolution of the mirror approach to fusion: Some conjectures.** Post, R.F. (Lawrence Livermore National Lab., Univ. of California, Livermore, CA 94550). pp 15-74 of Twenty years of plasma physics. Mc Namara, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-840932—).

From Meeting on plasma physics; Trieste, Italy (24 Sep 1984).

Some possible directions for the future evolution of the mirror approach to fusion are outlined, in the context of economically-motivated criteria. Speculations are given as to the potential advantages, economic and otherwise, of the use of axially-symmetric systems, operated in "semi-collisional" regimes of lower Q (fusion power balance ratio) than that projected for present-day tandem mirror designs. These regimes include "barely tandem" modes, and ion-heated modes, in association with higher efficiency direct conversion. Another possible economically advantageous approach mentioned is the use of a tandem mirror plasma to stabilize a FRM (field-reversed mirror) plasma, with potential synergistic advantages.

20195 (DOE/ER—0313/1, pp 18-21) **Capability for measuring millimeter-wave dielectric properties in free space and at elevated temperatures.** Frost, H.M. (Los Alamos National Lab., NM). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

This research provides a basis of comparison with the in-waveguide method for measuring dielectric constant "k" and loss tangent "tanδ" of fusion ceramics, and to extend measurement temperatures into the regime of first-wall temperatures in a magnetic fusion energy (MFE) reactor. 11 refs., 2 figs.

20196 (DOE/ER—0313/1, pp 22) **Operation of the US/Japan ORR [Oak Ridge Research Reactor] spectral tailoring experiments.** Siman-Tov, I.I. (Oak Ridge National Lab., TN). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The experiments in the US/Japan collaborative testing program in the ORR contain austenitic stainless steel alloys for possible use as first-wall and blanket structural materials in fusion reactors. These alloys will be irradiated with mixed-spectrum neutrons and with spectral tailoring to achieve the helium-to-displacement-per-atom (He/dpa) ratios predicted for fusion service. 5 refs.

20197 (DOE/ER—0313/1, pp 23-29) **Status of US/Japan collaborative testing in HFIR [High Flux Isotope Reactor] and ORR [Oak Ridge Research Reactor].** Scott, J.L.; Tanaka, M.P. Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this program is to determine the response of US and Japanese austenitic stainless steels to the combined effects of displacement damage and helium generation at temperatures in the range of 65 to 600°C. Since a basic understanding is sought in addition to an engineering data base, many advanced alloys and model alloys are included in the program. 6 refs., 10 tabs.

20198 (DOE/ER—0313/1, pp 38-40) **Neutronics analysis in support of the US-Japan spectral tailoring capsules.** Lillie, R.A. Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this work is to provide the neutronic design for materials irradiation experiments in both the Oak Ridge Research Reactor (ORR) and High Flux Isotope Reactor (HFIR).

Spectral tailoring to control the fast and thermal fluxes is required to provide the desired displacement and helium production rates in alloys containing nickel. 1 ref., 2 figs., 2 tabs.

20199 (DOE/ER—0313/1, pp 69-72) **Calculations for isotopically-tailored ceramics in fission and fusion reactors.** LaBauve, R.J.; Livak, R.J.; Clinard, F.W. Jr. (Los Alamos National Lab., NM). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

This work was done to calculate the isotopic compositions of sialon and alumina required to simulate the radiation response of these ceramics in the first wall of the STARFIRE fusion reactor by exposure in the HFIR reactor at Oak Ridge National Laboratory. 6 refs., 4 tabs.

20200 (DOE/ER—0313/1, pp 355-358) **The thermal conductivity of mixed beryllia/lithium ceramic in sphere-pac form.** Tam, S.W.; Johnson, C.E. (Argonne National Lab., IL). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this program is to explore a novel concept to enhance the thermal conductivity of mixed beryllia/lithium ceramic in sphere-pac form. 6 refs., 2 figs.

20201 (DOE/ER—0313/1, pp 359-361) **BEATRIX materials exchange in the international community.** Johnson, C.E.; Reuther, T.C.; Dupouy, J.M. (Argonne National Lab., IL; Dept. of Energy, Washington, DC; CEN/Saclay, France). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

A principal objective of this effort is to develop a collaborative program in which international partners will share data on irradiation behavior of ceramic breeder materials. This is being achieved through the auspices of Annex II to the International Energy Agency Implementing Agreement for a Program of Research and Development on Radiation Damage in Fusion Materials. 10 refs., 2 tabs.

20202 (DOE/ER—0313/1, pp 362-366) **Adsorption, dissolution, and desorption characteristics of the $LiAlO_2$-H_2O system.** Fischer, A.K.; Johnson, C.E. (Argonne National Lab., IL). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this work is to provide measured thermodynamic and kinetic data related to tritium retention and release from ceramic tritium breeders in fusion reactors. This information will enable breeders to be compared and the most suitable one to be selected, and enable operating conditions to be calculated. An additional objective is to elucidate the principles underlying the behavior of tritium in breeders as well as other interactions of breeders with reactor components. 6 refs., 4 figs.

20203 (DOE/ER—0313/1, pp 367) **Solid breeder materials fabrication and mechanical properties.** Poeppel, R.B. (Argonne National Lab., IL). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objectives of this program are to synthesize ceramic powders and/or fabricate samples of candidate solid breeder materials for various international cooperative irradiation test programs and to characterize the mechanical properties of a number of lithium ceramics. 4 refs.

20204 (DOE/ER—0313/1, pp 368-375) **Tritium and helium retained in fast neutron irradiated lithium ceramics as measured by high temperature vacuum extraction.** Baldwin, D.L.; Hollenberg, G.W. (Westinghouse Hanford Co., Richland, WA). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this effort is to develop a technique for measuring retained helium and tritium within lithium ceramics and to analyze materials irradiated in the FUBR-1A experiment. 15 refs., 6 figs., 1 tab.

20205 (DOE/ER—0313/1, pp 380-383) **The FUBR-1B experiment and BEATRIX-I.** Hollenberg, G.W.; Knight, R.C.; Pember, L.A.; Johnson, C.E.; Poeppel, R.B.; Yang, L. (Westinghouse Hanford Co., Richland, WA; Argonne National Lab., IL; GA Technologies, San Diego, CA). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this work is to irradiate lithium ceramics in a fast neutron environment to high burnup levels and with large temperature gradients. As a part of the BEATRIX-I, the object of the second part of this experiment is to irradiate materials from IEA participating countries in a similar manner.

20206 (DOE/ER—0313/1, pp 384-388) **Lithium transport within closed irradiation capsules containing lithium ceramics.** Hollenberg, G.W.; Baldwin, D.L.; Wisner, R.; Carlson, B. (Westinghouse Hanford Co., Richland, WA; Argonne National Lab., IL). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this work was to examine and explain the thermochemical stability of lithium oxide during irradiation to high burnup levels. 7 refs., 4 figs.

20207 (DOE/ER—0313/1, pp 389-396) **Pellet integrity and swelling of lithium ceramics.** Hollenberg, G.W. (Westinghouse Hanford Co., Richland, WA). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this effort is to determine the swelling and pellet integrity of Li_2O, Li_4SiO_4, Li_2ZrO_3, and $LiAlO_2$ after irradiation in a fast neutron fluence. 6 refs., 9 figs., 1 tab.

20208 (DOE/ER—0313/1, pp 397-398) **The effect of irradiation on the thermal conductivity of lithium ceramics.** Ethridge, J.L.; Baker, D.E. (Westinghouse Hanford Co., Richland, WA). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this effort is to determine the extent to which irradiation in a fast neutron flux influences the thermal conductivity of Li_2O and $LiAlO_2$. 4 refs., 1 fig.

20209 (DOE/ER/52125—6) **Swiss fusion blanket experiments: Final report, November 1, 1985-October 31, 1987.** Woodruff, G.L. (Washington Univ., Seattle (USA). Dept. of Nuclear Engineering). 13 Dec 1987. Contract FG06-86ER52125. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE88004586/JAW.

The major thrust of this project related to the effort to transfer the Lithium Blanket Module (LBM) to the Nuclear Engineering Laboratory of the Swiss Institute of Technology at Lausanne, and to the subsequent support with analytical calculations of a variety of experiments performed with the LBM. 12 refs.

20210 (ENEA-RT-FUS—86-7, pp 23-28) **Il Mantello. A Helium cooled solid breeder blanket for NET.** Anzidei, L.; Gallina, M.; Rado, V. (ENEA, Frascati, Italy. Centro Ricerche Energia). 1987. NTIS (US Sales Only), PC A06. Order Number DE87752631/JAW. (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

The paper reports on the completion of Il Mantello, an engineering design study of a Helium cooled, ceramic breeder blanket for NET. Aiming at improving the nuclear performance of the reference configuration, a design variant has been introduced that is based on the use of a mixed breeding moderator material (Be and γ LiAlO/sub 2/ separated by a thin steel sheath). The problems of assembly and operation of such blanket modules, within an outboard sector of the closed box structure envisaged for the NET first wall, have been thoroughly investigated. The main conclusions of the study, together with the consequent implications and guidelines for future blanket design work to be performed at ENEA-Frascati, are discussed.

20211 (ENEA-RT-FUS—86-7, pp 35-40) **Effects of openings in a fusion reactor blanket. Tokamak type.** Robouch, B.V.; Ingrosso, L.; Brzosko, J.S. (ENEA, Frascati, Italy. Centro Ricerche Energia; Stevens Inst. of Tech., Hoboken, NJ, USA. Dept. of Physics). 1987. NTIS (US Sales Only), PC A06. Order Number DE87752631/JAW. (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

The paper briefly reports on the consequences of the introduction of openings (heating, pumping, maintenance ducts, limiter, etc.) in a fusion reactor (FR) blanket (with tokamak physics) on its nuclear characteristics; considered designs cover a wide variety of breeding materials and blanket thicknesses. Numerical calculations confirm the possibility for an analytical extrapolation/interpolation of the nuclear parameters of a blanket in a very wide class of openings in the breeders.

20212 (ENEA-RT-FUS—86-7, pp 71-77) **Electromagnetic effects of the use of ferromagnetic materials within the NET machine.** Mitchell, N.; Pasotti, G.; Ricci, M.V. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen, Germany, F.R.; ENEA, Frascati, Italy. Centro Ricerche Energia). 1987. NTIS (US Sales Only), PC A06. Order Number DE87752631/JAW. (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

The inclusion of ferromagnetic materials in the close proximity of the plasma is being considered in the design of the NET machine. The use of these materials is of interest in two areas: 1) In the blanket and first wall design, where (ferromagnetic) martensitic steels offer improvements over austenitic, in terms of higher thermal conductivity and lower thermal expansion, thermal creep and void swelling. The ferromagnetism is an unwanted side effect. 2) In the toroidal field coil design, where ferromagnetic inserts may be considered to reduce the toroidal field coil ripple at the plasma boundary. The effect of ferromagnetism has to be investigated from the viewpoints of toroidal and poloidal field, since although the field levels are such that the steel is saturated, the direction of the magnetisation vector can change with the time varying fields. The codes GFUN and TOSCA have been used with simplified geometric representations to analyse the various aspects of the effects of the ferromagnetics.

20213 (ENEA-RT-FUS—86-7, pp 65-70) **Thermal and stress analysis of the solid BOT blanket for NET.** Ferrari, M.; Simbolotti, G. (ENEA, Frascati, Italy. Centro Ricerche Energia). 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE87752631/JAW. (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

Within the frame-work of the collaboration with the NET team on blanket design studies, thermal and stress analysis of the Breeder Out of Tubes (BOT) blanket for NET DN are in progress at ENEA-Frascati. The present paper reports on results of the finite elemant thermal analysis. Special emphasis is placed on the effects of contact thermal resistences between different materials and possible breeder cracking due to thermal stresses and irradiation.

20214 (ENEA-RT-TIB—86-4) **Comparison between EURLIB-4 and VITAMIN-C libraries with respect to a shielding reference problem.** Borgia, M.G.; Panini, G.C.; Pescarini, M. (ENEA, Rome (Italy)). 1986. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701279/JAW.

A comparison between two (ENDF/B IV) multigroup shielding libraries VITAMIN-C and EURLIB-4, is reported, using as a reference, the shield geometry and hipothetical composition of a BWR of 1000 MWe. 2 Figs.

20215 (ENEA-RT-TIB—86-11) **Tritium dynamics in fusion reactor solid breeder.** Violante, V. (ENEA, Rome (Italy)). 1986. 41p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701281/JAW.

In the field of the NET research progrm, the chemical and diffusive processes involved in solid ceramic breeder materials have been analysed. A mathematical model describing the phenomena has been developed to obtain a quantitative evaluation for a first design approach. The data obtained by means of the above mentioned model are in good agreement with the data obtained by other research groups working in Europe and in United States. The computer codes BLANKET2, MC2, FWBC, have been developed to simulate the phenomena. 21 refs.

20216 (GA-A—19101) **A summary of divertor operation in DIII-D.** Hill, D.N.; Allen, S.; Brooks, N.H.; Content, D.; DeBoo, J.C.; Gohil, P.; Haas, G.; Heifetz, D.; Hsieh, C.L.; Hulse, R.A. (GA Technologies, Inc., San Diego, CA (USA); Lawrence Livermore National Lab., CA (USA); Johns Hopkins Univ., Baltimore, MD (USA); Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Princeton Univ., NJ (USA). Plasma Physics Lab.; Japan Atomic Energy Research Inst., Tokyo). Nov 1987. Contract AC03-84ER51044;W-7405-ENG-48. 19p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005351/JAW.

Impurities must be controlled in high temperature tokamak plasmas because the impurity radiation can limit the plasma temperature to values below that required for ignition. Impurity influx can be reduced with the use of the magnetic divertor configuration, which surrounds the hot dense plasma with a much cooler plasma that contacts material walls only on open field lines. In DIII-D, good H-mode confinement has been obtained with up to 6MW of neutral-beam injection. This report summarizes the essential features of divertor operation for DIII-D H-mode plasmas. The report is divided into sections which briefly describe the DIII-D tokamak and relevant diagnostics, summarize the divertor plasma parameters obtained during the H-mode and describe the heat loads on the divertor target plates, and present the results of measurements of the central radiation and impurity content using data from an EUV spectrometer and a 21 channel bolometer array. 6 refs., 8 figs.

20217 (IAE—4171/8) **Total absorption method for measuring the multiplication coefficients of 14 MeV neutrons.** Zagryadskij, V.A.; Markovskij, D.V.; Novikov, V.M.; Chuvilin, D.Yu.; Shatalov, G.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 15p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703177/JAW.

Methodical problems of experiments on the measurement of neutron leakage from spherical assemblies simulating thermonuclear reactor blanket multiplication zones are considered. Boron tank is considered as a neutron detector, as compared with other total absorption detectors has a number of advantages. Results of calculations showed that investigated assembly surrounded by a layer of borated water, playing the role of a neutron detector, does not affect the process of 14 MeV neutron multiplication. The boron tank has a constant efficiency of neutron recording in the energy range of 0-6 MeV. A technique to measure neutron leakage from spherical samples with the central source of 14 MeV neutrons is suggested.

20218 (IAE—4197/8) Measurement of the multiplication factor for 14 MeV neutrons in Pb and Bi spherical assemblies by the total absorption method. Novikov, V.M.; Chuvilin, D.Yu.; Zagryadskij, V.A.; Krajnev, M.I.; Markovskij, D.V.; Shatalov, G.E. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703187/JAW.

The accuracy of thermonuclear reactor blanket design parameters prediction depends on reliability of the nuclear constants used in calculations. Measurement of neutron leakage from lead and bismuth spherical assemblies normalized to one 14-MeV neutron of the source has been carried out by the method of a boron tank. The measurement results on lead were compared with the calculation carried out by the BLANK program with lead constants from ENDL library. Comparison showed that the calculation of 0.065 +- 0.039 for lead assemblies with 3 cm in thick and of 0.080 +- 0.047 with 9 cm under-estimated the value of absolute leakage of neutrons. The conclusion has been made that the cross section of (n, 2n)-reaction with lead is under-estimated in the data used. 21 references, 5 figures.

20219 (IAE—4231/8) Sorption properties of lithium at low pressures. Voronkov, O.G.; Zubarev, V.F. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 20p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703194/JAW.

Results of investigations into sorption rate of D_2N_2, CO, CO_2O_2 from thermonuclear reactor vacuum atmosphere with sputtered lithium films and compact lithium in the temperature range from 20 to 250 deg C at 10^{-4}-10^{-3} Pa pressures are given. Sorption capacities for the given gases are measured as well. It is shown that probability of contamination of flowing lithium film with products of its interaction with residual gases of vacuum system is low. 22 references, 8 figures.

20220 (IAEA-TECDOC—441, pp 7-25) **Impurity control modelling. Summary report.** Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-8509441—; CONF-860995—; CONF-861218—; CONF-8606376—).

From Specialists' meeting on impurity control modelling; Vienna, Austria (16 Sep 1985).

The main purpose of this INTOR Technical Experts Meeting was to formulate the requirements for an adequate divertor model, as a result of the discussions of the relative merits of different approaches to developing sophisticated two-dimensional computational models for poloidal divertors. This summary covers the following topics: two-dimensional fluid codes, neutral particle transport models, impurity transport models, plasma boundary modelling and experimental results, boundary conditions, application of models to design (INTOR) and new directions.

20221 (ORNL/TM—10649) One-dimensional S/sub N/ calculations to evaluate the shielding for an alpha-particle charge exchange neutral analyzer. Santoro, R.T.; Dagenhart, W.K.; Barnes, J.M. (Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004777/JAW.

One-dimensional discrete ordinates calculations have been carried out to estimate the effectiveness of both concrete and stainless-steel plus borated water shadow shields in reducing the neutron and gamma-ray background levels at an alpha-particle charge exchange neutral analyzer. The system is proposed for studying the alpha particle and plasma characteristics of fusion machines with ignited plasmas such as the CIT. A stainless-steel-borated water shield was determined to be effective in reducing background counting rates. 10 refs., 4 figs., 1 tab.

20222 (SAND—87-1361C) Deposition of carbon, deuterium and metals on the wall and limiters of TFTR. Wampler, W.R.; Doyle, B.L.; Lee, S.R.; Pontau, A.E.; Mills, B.E.; Causey, R.A.; Buchenauer, D.; Dylla, H.F.; Ulrickson, M.A.; LaMarche, P.H. (Sandia National Labs., Albuquerque, NM (USA); Sandia National Labs., Livermore, CA (USA); Princeton Univ., NJ (USA). Plasma Physics Lab.). 1987. Contract AC04-76DP00789. 23p. (CONF-871125—19). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004941/JAW.

From 34. national vacuum symposium and topical conference; Anaheim, CA, USA (2 Nov 1987).

Following a two year operational period the TFTR graphite fixed bumper limiter has been examined by a variety of methods. The areal density of metals was mapped in-situ by beta-backscattering. Several tiles were examined in detail by nuclear-reaction analysis, Rutherford backscattering and proton-induced x-ray emission to measure areal densities of deuterium and impurities. Some areas of the limiters were found to be covered by deposited material several microns thick. Other areas where the incident plasma flux is higher were much cleaner. Long-term collection coupons were also examined to characterize deposition on the wall. From these results the total amount of deuterium on the limiter and wall in TFTR is estimated to be about 1.3×10^{24} atoms. The implications of this for wall-pumping effects and future tritium inventory are discussed. 11 refs., 5 figs., 1 tab.

20223 (UCRL—97334) TIBER II/ETR [Engineering Test Reactor] nuclear shielding and optional tritium breeding system: An overview. Lee, J.D.; Sawan, M. (Lawrence Livermore National Lab., CA (USA); Wisconsin Univ., Madison (USA). Fusion Technology Inst.). 2 Nov 1987. Contract W-7405-ENG-48. 5p. (CONF-871007—77). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88004404/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

TIBER II, the Tokamak Ignition/Burn Experimental Reactor II, is a design concept developed as the US candidate for an International Engineering Test Reactor (ETR). An important objective of this design is to minimize cost by minimizing major radius while providing a wall loading greater than 1.0 MW/m2 and a total fluence greater than 3.0 MWY/m2 needed for blanket module testing. The shielding required for the superconducting TF coils is an important element in setting TIBER II's 3.0m major radius. 6 refs., 1 fig., 1 tab.

20224 Two-dimensional toroidal geometry neutral atom transport and material erosion rates in the TEXTOR and TFTR Tokamaks. Hasan, M.Z.; Conn, R.W. (Univ. of California, Los Angeles Mechanical, Aerospace, and Nuclear Engineering Dept., Center for Plasma Physics and Fusion Engineering, Los Angeles, CA 90024). *Fujitsu Scientific and Technical Journal;* 12: No. 3, 416-421(Nov 1987).

The power deposition and wall material erosion rates due to charge-exchange neutral atoms resulting from a recycling source at limiters in the TEXTOR and Tokamak Fusion Test Reactor tokamaks are reported. The analysis is carried out using a recently developed finite element, two-dimensional toroidal geometry diffusion theory, neutral atom transport theory, and the computer code FENAT. The power deposition and material erosion are highest at the limiter. The first wall suffers very little erosion except for the portion near the limiter.

20225 A hybrid blanket for a reversed-field pinch reactor. Jaeger, J.F.; Dudziak, D.J.; Friedrich, G.; Green, W.V.; Groner, P.; Huggenburger, M.; Kohler, P.; Marmy, P.; Pelloni, S.; Stepanek, J. (Swiss Federal Institute for Reactor Research, CH-5303 Wurenlingen). *Fujitsu Scientific and Technical Journal;* 12: No. 3, 364-379(Nov 1987).

A hybrid blanket for a reversed-field pinch (RFP) reactor is presented for breeding /sup 233/U from thorium. This study focuses on the shell/blanket design and assumes a plasma like that used by Culham Laboratory (CL) in its designs. The /sup 233/U bred helps the important neutron economy and allows the tritium

breeding ratio to be 0.96 at beginning of life for a mean of 1.06 for a 9 MW . yr/m/sup 2/ burnup. A thick conducting shell is assumed for discharge stability and field reversal. This need for a good conductor requires that only pure copper or aluminum or alloys thereof be used.

20226 **Vanadium alloys for fusion reactor first wall application.** Braski, D.N.; Tortorelli, P.F. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **52**: 224(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The first wall of a tokamak-type of fusion reactor separates the blanket/coolant from the plasma, provides for mechanical stability of the torus, and maintains a vacuum in the plasma chamber. Current tokamak designs require the first wall to withstand a neutron flux of 0.4 to 1.2 x 10^{19} neutron x m^{-2} x s^{-1}, with 20% of the neutrons having an energy of 14.1 MeV. In addition to the high displacement damage, fusion neutrons will produce 20 to 30 times more helium and hydrogen in the wall than a reactor like Experimental Breeder Reactor II (EBR-II). Recently, the need for the first wall to demonstrate a low residual activity created a renewed interest in the refractory metal vanadium. Compared to the austenitic and ferritic stainless steels, vanadium and its alloys also provide lower thermal stresses for given flux, good strength at elevated temperatures, excellent compatibility with lithium (a proposed coolant/blanket material), and lower nuclear heating, helium generation, and void-swelling rates. Major concerns regarding the use of vanadium alloys for a first wall include: cost, reactivity with light elements (carbon, nitrogen, oxygen, and hydrogen) as well as various coolant/blanket materials, and resistance to radiation damage. These latter two areas will be reviewed in this paper.

20227 **Measurements of reactor-relevant electromagnetic effects with the FELIX facility.** Turner, L.R.; Hua, T.Q.; Knott, M.J.; Lee, S.Y.; McGhee, D.G.; Wehrle, R.B. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **52**: 234-235(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

In predicting the electromagnetic consequences of a plasma disruption in a tokamak reactor design, a two-dimensional electromagnetic model of the first wall, blanket, and shield (FWBS) system is typically used. The response to a decaying plasma current is then found to be dominated by a single eddy-current mode, with a single L/R time. Recent experiments with the Fusion ELectromagnetic Induction eXperiment (FELIX) facility at Argonne National Laboratory suggest that such modeling can be used to design against electromagnetic forces and torques, but only if a range of values is used for both tau, the plasma decay time, and tau_0, the L/R time of the FWBS system.

20228 **BEATRIX - the international breeder materials exchange.** Johnson, C.E.; Reuther, T.C.; Dupouy, J.M. (Argonne National Lab., IL, USA; USDOE Office of Energy Research, Washington, DC. Office of Fusion Energy; Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.). pp 1197-1201 of Fusion technology 1986. 2 Vols. Proceedings of the fourteenth symposium, Congress Center of the Palais des Papes, Avignon, France, 8-12 September 1986. Oxford, England; Pergamon Press (1986). (EUR—10936-EN; CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

The Beatrix experiment is an IEA-sponsored effort that involves the exchange of solid breeder materials and shared irradiation testing among research groups in several countries. The materials will be tested in both closed capsules (to evaluate material lifetime) and opened capsules (to evaluate purge-flow tritium recovery). Pre- and post-irradiation measurement of thermophysical and mechanical properties will also be carried out.

20229 **Ceramic tritium breeder materials - promise and performance.** Johnson, C.E.; Hollenberg, G.W. (Argonne National Lab., IL, USA; Westinghouse Hanford Co., Richland, WA, USA). pp 1249-1253 of Fusion technology 1986. 2 Vols. Proceedings of the fourteenth symposium, Congress Center of the Palais des Papes, Avignon, France, 8-12 September 1986. Oxford, England; Pergamon Press (1986). (EUR—10936-EN; CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

A critical element in the D-T fusion reactor design is the tritium-producing blanket. The lithium-containing ceramic materials Li/sub 2/O, γ-LiA10/sub 2/, Li/sub 4/SiO/sub 4/, and Li/sub 2/ZrO/sub 3/ are being strongly considered as candidates for producing tritium. Materials properties data are being collected to provide a basis for evaluation and selection of a prime candidate material.

20230 **ORNL fusion integral experiment/analysis program.** Santoro, R.T.; Barnes, J.M.; Alsmiller, R.G. Jr.; Drischler, J.D. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **52**: 113-114(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

During the past 7 yr, the Oak Ridge National Lab. has been tasked by the Office of Fusion Energy, US Dept. of Energy, to conduct a series of integral experiments to provide data for validating the radiation transport methods and nuclear data that are used for nuclear design calculations for fusion reactors. The program focused on two kinds of experiments: (a) the measurement of neutron and gamma-ray spectra resulting when 14-MeV neutrons incident on bulk shields of different composition and thickness, and (b) the measurement of neutron and gamma-ray spectra as a function of detector location relative to the mouths of straight cylindrical ducts of different length-to-diameter ratios when 14-MeV neutrons were incident on the ducts.

20231 **Comparisons of calculated and measured spectral distributions of neutrons from a 14-MeV neutron source inside the Tokamak Fusion Test Reactor.** Santoro, R.T.; Barnes, J.M.; Alsmiller, R.G. Jr.; Emmett, M.B.; Drischler, J.D. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **52**: 114-116(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Tokamak fusion reactors will have very complex geometric configurations, so it is necessary to determine whether state-of-the-art radiation transport codes and nuclear data are adequate for performing calculations for shielding and blanket design for these reactors. Since there are currently no operating fusion reactors, validation of the codes and data has had to rely on measured data obtained using 14-MeV neutron sources. Recently, a series of measurements was completed at the Tokamak Fusion Test Reactor (TFTR) at the Princeton Plasma Physics Lab. to determine the neutron spectral distributions (neutron energy > 0.91 MeV) at locations outside the TFTR when a point source of 14-MeV neutrons was positioned at various locations inside the TFTR vacuum vessel. In this paper, calculated neutron spectra obtained using the Monte Carlo code MORSE with a realistic model of the TFTR are compared with the measured data. The measured and calculated integral neutron fluences and the ratios of the calculated-to-measured data for neutrons with energies > 0.91 MeV are shown. The uncertainties were calculated assuming uncorrelated data. These data were obtained by integrating the measured and calculated differential neutron spectra that include the energy-dependent resolution of the detector. The calculation reproduces the measurement within a factor of ~ 3, which is not unreasonable for an absolute comparison using such a complicated geometry. The calculated differential data reproduce the measurements in shape at all detector locations, although significant differences occur at some energies due to statistical variations in the measured and calculated data. These results do, however, indicate that considerable confidence can be placed on current transport methods and data for fusion reactor design calculations.

20232 **Status of fusion reactor blanket design.** Smith, D.L.; Sze, D.K. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **52**: 118-119(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The recent Blanket Comparison and Selection Study (BCSS), which was a comprehensive evaluation of fusion reactor blanket design and the status of blanket technology, serves as an excellent basis for further development of blanket technology. This study provided an evaluation of over 130 blanket concepts for the reference case of electric power producing, deuterium-tritium-fueled reactors in both tokamak and tandem mirror reactor (TMR) configurations. Based on a specific set of reactor operating parameters, the current understanding of materials and blanket technology, the a uniform evaluation methodology developed as part of the study, a limited number of concepts were identified that offer the greatest potential for making fusion an attractive energy source.

20233 **Helium-cooled, flibe breeder, beryllium multiplier blanket for MINIMARS.** Moir, R.W.; Lee, J.D. (Lawrence Livermore National Lab., CA). *Transactions of the American Nuclear Society;* **52**: 122-124(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The helium-cooled, Flibe breeder blanket formed the basis for the Princeton Reference Design-the first, large, multidisciplinary fusion reactor design study. With this design, tritium breeding is submarginal, but adding beryllium corrects this problem. A large amount of beryllium in a zone of pebbles 0.5 m thick results in such a good breeder that the idea has formed the basis for the fusion breeder design described. One fusion breeder plant of this design can produce 1 GW(e) of electricity and enough fissile material (6 tonne/yr) to provide makeup fuel for fifteen 1-GW(e) light water reactors. The electric power plant version of this fusion reactor was proposed to the Blanket Comparison and Selection Study (BCSS) for evaluation on a common basis with other designs.

20234 **Conceptual design of a self-cooled Flibe blanket.** Sze, D.K.; Cheng, E.T.; Jung, J.; Piet, S.; Klein, A. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **52**: 124-125(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

There are a number of attractive features for Flibe, such as: (1) low-pressure operation, (2) relatively inert to air and water, (3) low activation, (4) high-temperature stability, and (5) low electrical conductivity. If these features can be incorporated into a self-cooled blanket, a simple, high-performance, and reliable blanket may be possible. Detailed analysis has uncovered some attractive features and some potential problems. A highly compact and efficient primary loop can be developed with a conversion efficiency of 46%. The blanket is designed to be inherently safe for at least a 4.7 MW/m^2 neutron wall loading. Since no reflector is needed, the mass utilization is very high. A similar blanket for MINIMARS has a mass utilization figure of 138 kW(e)/tonne, the highest among the four blanket candidates. In addition, a very simple blanket can be designed. There is, however, concern about the lithium doping idea for tritium control. The issues cannot be resolved until experimental verification is available. However, if a vanadium alloy is used for the structural material, a large fraction of tritium will permeate back through the first wall to the plasma. Permeation through the first wall will result in a tritium partial pressure of $< 10^{-4}$ Torr. If this is the case, the primary blanket tritium recovery system can be combined with the plasma exhaust system. A highly efficient tritium cleanup system will still be required to reduce the tritium permeation problem. A countercurrent extraction system can be used for tritium cleanup.

20235 **Economic comparison of tandem mirror fusion reactor blankets.** Perkins, L.J. (Lawrence Livermore National Lab., CA). *Transactions of the American Nuclear Society;* **52**: 125-127(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

During 1985-1986, we are conducting the conceptual design of MINIMARS, a small commercial tandem mirror reactor with novel octopole end plugs. With a net electric output of 600 MW(e), MINIMARS is expressly designed for a short construction time, factory-built modules, and a passively safe blanket and thermal cycle. From the outset of the study, we sought a blanket design that enabled us to achieve the lowest possible cost of electricity (COE) while maintaining engineering credibility and emphasizing passive/inherent safety. Accordingly, four candidate blankets were selected for study during the project. Each blanket was independently configured by a separate advocacy group with the intention of selecting the best blanket for the final reactor design. The selection process encompassed a number of criteria, including economic performance, critical R & D issues, ability to meet inherent/passive safety requirements, vulnerability to the design-basis accident, waste disposal rating, etc. In this paper, we examine the comparison of economic performance.

20236 **Integrated first-wall/blanket/shield concept.** Gohar, Y. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **52**: 130-131(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

An integrated first-wall/blanket/shield concept has evolved from the desire to improve the attractiveness and reduce the capital cost of fusion reactors. Design simplicity, improved safety, high performance, and reactor modularization are the key design factors in developing this concept. The main features and analysis of the concept are the subject of this paper.

20237 **Flibe-vanadium alloy system corrosion product radiation hazards analysis.** Klein, A.C.; Sze, D.K. (Oregon State Univ., Corvallis). *Transactions of the American Nuclear Society;* **52**: 157-158(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Radioactive corrosion and neutron sputtering products generated within the heat removal and tritium breeding systems of fusion power plants have been shown to be a source of radiation protection problems to operational personnel. Previous studies have shown that certain combinations of structural materials and tritium breeding and/or heat transfer fluids can lead to extremely high gamma radiation fields in the neighborhood of these systems and preclude the possibility of hands-on access for maintenance and repair tasks. The combination of the heat transfer and tritium breeding salt Flibe with a vanadium alloy structure for a self-cooled breeding blanket has recently been shown to have a number of significant advantages. The purpose of this paper is to describe the results of analysis for this combination of materials with respect to the potential radiation fields likely to be produced by radioactive corrosion and products deposited throughout the primary system.

20238 **Techniques for measurement of velocity in liquid-metal MHD flows.** Reed, C.B.; Bailey, J.L.; Dauzvardis, P.; Picologlou, B.F. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **52**: 187-188(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Recent blanket studies have demonstrated that magnetohydrodynamics (MHD) presents a critical feasibility issue for liquid-metal, self-cooled tokamak blankets. Although successful designs have been developed using available theory and data on liquid-metal MHD, a number of uncertainties related to MHD effects remain unresolved. To improve the level of understanding of the details of MHD flows as they apply to magnetically confined fusion blankets, an experimental program is being carried out in a facility at Argonne National Lab. The experimental facility [Argonne Liquid-Metal Engineering Experiment (ALEX) described in detail elsewhere] is capable of attaining maximum Hartmann numbers (M)/sup b/, and interaction parameters (N)/sup c/ in the range of 10^3 to 10^4, which is close to the range of 10^4 to 10^5 that these parameters attain in the reactor blanket. The experimental program is aimed toward measurement of detailed flow structure characteristics. This is of fundamental importance because existing theories predict unconventional velocity profiles with high-velocity wall jets and low-velocity core regions, in the case where three-dimensional

effects become dominant. Since three-dimensional effects are virtually unavoidable in the blanket, and because the flow profiles have a strong influence on heat transfer and corrosion rates, data validating existing theories are indispensable to design efforts seeking to either minimize or take advantage of such effects. This paper describes three separate velocity measuring systems currently under development and presents the first results obtained from each in ALEX.

20239 **Lithium-cooled blankets for advanced tokamaks.** Picologlou, B.F.; Cha, Y.S.; Majumdar, S. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **52**: 191-192(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The main objective of the Tokamak Power System Studies (TPSS) at Argonne National Lab. during fiscal year 1985 was to explore innovative design concepts that have the potential for significant enhancement of the attractiveness of a tokamak-based power plant. Activities in the area of plasma engineering resulted in a reference reactor concept, which served as a model for the impurity control and first-wall/blanket/shield studies. The liquid-metal-cooled first-wall/blanket/shield design activity was centered around the vanadium alloy structure and liquid-lithium coolant leading blanket concept as identified by the Blanket Comparison and Selection Study (BCSS). A ferritic steel structure and a LiPb breeder were considered as backup options. The magnetohydrodynamics (MHD) effects associated with self-cooled liquid-metal blanket/first-wall systems are substantially reduced by the lower magnetic fields required for higher plasmas, the lower neutron wall loading resulting from reduced power output, and the smaller reactor size of the TPSS model reactor. Therefore, improved performance characteristics of self-cooled liquid-metal blanket concepts are achievable mainly because the design constraints are more relaxed compared to the BCSS guidelines. Key aspects of the designs evaluated in the current study include the following: (1) design simplicity; (2) use of the first wall as an impurity control device; (3) modular first-wall/blanket/reflector/shield construction; and (4) integrated first-wall/blanket/reflector/shield.

20240 **Analytical and experimental investigations of magnetohydrodynamic flows near the entrance to a strong magnetic field.** Picologlou, B.F.; Reed, C.B.; Dauzvardis, P.V.; Walker, J.S. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **52**: 194(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

A program of analytical and experimental investigations in MHD flows has been established at Argonne National Lab. (ANL) within the framework of the Blanket Technology Program. An experimental facility for such investigations has been built and is being operated at ANL. The investigations carried out on the Argonne Liquid-Metal engineering EXperiment (ALEX) are complemented by analysis carried out at the Univ. of Illinois. The first phase of the experimental program is devoted to investigations of well-defined cases for which analytical solutions exist. Such testing will allow validation and increased confidence in the theory. Because analytical solutions exist for only a few cases, which do not cover the entire range of anticipated flow behavior, confining testing to these cases will not be an adequate validation of the theory. For this reason, this phase involves testing and a companion analytical effort aimed toward obtaining solutions for a broad range of cases, which, although simple in geometry, are believed to encompass the range of flow phenomena relevant to fusion. This parallel approach is necessary so that analysis will guide and help plan the experiments, whereas the experimental results will provide information needed to validate and/or refine the analysis.

20241 **Comparison of two MHD flow control methods for self-cooled liquid-metal blankets of magnetic confinement fusion reactors.** Walker, J.S.; Picologlou, B.F. (Univ. of Illinois, Chicago). *Transactions of the American Nuclear Society;* **52**: 194(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

In a fusion reactor blanket, most of the energy is deposited at or near the first wall. In magnetic confinement reactors, the strong magnetic field eliminates any turbulence in a self-cooled liquid-metal blanket. Without turbulent mixing, unacceptable temperature gradients develop in the liquid metal if the velocity is uniform. However, if we can induce nonuniform velocity profiles with large velocities near the first wall where most of the energy is deposited, then we can maintain a uniform temperature in the liquid metal. Several possible methods of producing such nonuniform velocity profiles by using the dominant electromagnetic force to guide the flow have been presented. The purpose of the present paper is to apply the analysis to geometries that would be realistic for fusion blankets.

20242 **Analysis of LBM experiments at LOTUS.** Stepanek, J.; Davidson, J.W.; Dudziak, D.J.; Haldy, P.A.; Pelloni, S. *Transactions of the American Nuclear Society;* **52**: 207-209(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

A Lithium Blanket Module (LBM) has been designed at General Atomic Company [under subcontract to Princeton Plasma Physics Lab. (PPPL), the Electric Power Research Institute (EPRI) contractor] for testing on the Tokamak Fusion Test Reactor (TFTR). The LBM has both realistic fusion blanket materials and configuration and has been designed for detailed experimental analyses of tritium breeding and neutron flux spatial/spectral distributions. It is ~ 80 cm^3 and the breeding material is Li_2O. This configuration will be evaluated experimentally at the LOTUS facility and computationally by the LANL/EIR analysis program.

20243 **LBM program at the LOTUS facility.** File, J.; Haldy, P.A.; Jassby, D.L.; Leo, W.R.; Tsang, F.Y. (Princeton Plasma Physics Lab., NJ). *Transactions of the American Nuclear Society;* **52**: 209-211(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The Ecole Polytechnique Federale de Lausanne's (EPFL's) LOTUS facility in Lausanne, Switzerland, consists of a point-neutron deuterium-tritium (D-T) source in a shielded room designed specifically for neutronics experiments with fusion blanket modules. In 1985 the Electric Power Research Institute and EPFL initiated an experimental neutron transport program using irradiation of the Lithium Blanket Module (LBM) by the LOTUS neutron source. The principal objectives of this program are: (a) to test the capability of present-day neutron transport codes to predict the neutronic performance, including tritium breeding, of a reactor-representative blanket module in a relatively simple fast-neutron field and (b) to develop and verify the measurement and data processing procedures that will be used eventually with the LBM experiments at the Tokamak Fusion Test Reactor (TFTR) at Princeton Plasma Physics Lab. (PPPL).

20244 **Neutronic analysis for the LBM/LOTUS experiment.** Kolibal, J.; Ku, L.P.; Liew, S.L. (Princeton Plasma Physics Lab., NJ). *Transactions of the American Nuclear Society;* **52**: 211-212(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The LBM/LOTUS experimental results will be compared with the calculated values using the MCC in early 1986 based on the MCNP and DOT models described. The comparison will allow a testing of the features of the MCC in a simplified situation, in preparation for the ultimate experiment of the LBM on TFTR.

20245 **Tritium assay of Li_2O pellets in the LBM/LOTUS experiments.** Quanci, J.; Azam, S.; Bertone, P. (Princeton Plasma Physics Lab., NJ). *Transactions of the American Nuclear Society;* **52**: 214(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

One of the objectives of the Lithium Blanket Module (LBM) program is to test the ability of advanced neutronics codes to model the tritium breeding characteristics of a fusion blanket exposed to a toroidal fusion neutron source. The LBM consists of over 20,000 cylindrical lithium oxide pellets and numerous diagnos-

tic pellets and wafers. The LBM has been irradiated at the Ecole Polytechnique Federale de Lausanne (EPFL) LOTUS facility with a Haefely sealed neutron generator that gives a point deuterium-tritium neutron source up to 5 x 10^{13} 14-MeV n/s. Both Princeton Plasma Physics Lab. (PPPL) and EPFL assayed the tritium bred at various positions in the LBM. EPFL employed a dissolution technique while PPPL recovered the tritium by a thermal extraction method.

20246 **Thermodynamic performance of tritium breeding ceramic blanket materials.** Johnson, C.E.; Fischer, A.K. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **52**: 217(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Tritium breeding materials are essential to the operation of deuterium-tritium fusion reactors. Currently, emphasis is being directed at evaluation of the lithium-containing oxides; e.g., Li_2O, γ-$LiAlO_2$, Li_4SiO_4, and Li_2ZrO_3. The prime candidate material must satisfy many requirements including desirable neutronic and irradiation characteristics, chemical and morphological stability including resistance to sintering at operating temperatures, compatibility with structural and other blanket materials, and rapid tritium release coupled with low retention. In this paper, comparisons are made of the results from a series of ideal solution calculations for all species of Li_2O (except LiOH in Li_2O), $LiAlO_2$, and Li_4SiO_4. The SOLGASMIX code was used for calculating the equilibria of multielement/multispecies gas and condensed phases, based on the minimization of system free energy. Thermodynamic calculations have been made to predict the thermochemical performance of the candidate materials for the 900 to 1300 K temperature range and oxygen activity range of 10^{-25} to 10^{-5}.

20247 **Required momentum, heat, and mass transport experiments for liquid-metal blankets.** Tillack, M.S.; Sze, D.K.; Abdou, M.A. (Univ. of California, Los Angeles). *Transactions of the American Nuclear Society;* **52**: 238(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Through the effects on fluid flow, many aspects of blanket behavior are affected by magnetohydrodynamic (MHD) effects, including pressure drop, heat transfer, mass transfer, and structural behavior. In this paper, a set of experiments is examined that could be performed in order to reduce the uncertainties in the highly related set of issues dealing with momentum, heat, and mass transport under the influence of a strong magnetic field (i.e., magnetic transport phenomena). By improving our basic understanding and by providing direct experimental data on blanket behavior, these experiments will lead to improved designs and an accurate assessment of the attractiveness of liquid-metal blankets.

20248 **Fusion blanket inherent safety assessment.** Sze, D.K.; Jung, J.; Cheng, E.T. (GA Technologies, Inc., San Diego, CA). *Transactions of the American Nuclear Society;* **52**: 248-249(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Fusion has significant potential safety advantages. There is a strong incentive for designing fusion plants to ensure that inherent safety will be achieved. Accordingly, both the Tokamak Power Systems Studies and MINIMARS have identified inherent safety as a design goal. A necessary condition is for the blanket to maintain its configuration and integrity under all credible accident conditions. A main problem is caused by afterheat removal in an accident condition. In this regard, it is highly desirable to achieve the required level of protection of the plant capital investment and limitation of radioactivity release by systems that rely only on inherent properties of matter (e.g., thermal conductivity, specific heat, etc.) and without the use of active safety equipment. This paper assesses the conditions under which inherent safety is feasible. Three types of accident conditions are evaluated for two blankets. The blankets evaluated are a self cooled vanadium/lithium blanket and a self-cooled vanadium/Flibe blanket. The accident conditions evaluated are: (1) loss-of-flow accident; (2) loss-of-coolant accident (LOCA); and (3) partial loss-of-coolant accident.

20249 **Nuclear performance optimization of the molten salt fusion breeder.** Lee, J.D.; Bandini, B.R. (Lawrence Livermore National Lab., CA). *Transactions of the American Nuclear Society;* **52**: 272-273(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The fusion breeder program is investigating the potential of producing fissile fuels with fusion neutrons. This paper reports on refined nuclear analysis, including the treatment of resonance and spatial self-shielding, coupled with an optimization procedure, of a 1985 molten salt fusion breeder design. The blanket of this tandem mirror-based fusion breeder contains beryllium pebbles for neutron multiplication, molten salt in steel tubes for tritium and ^{233}U breeding, and is cooled by helium. Results of this work are encouraging. The effect of using a more rigorous method to treat spatial self-shielding, potentially deleterious, are mostly overcome by optimization. With 3 vol% steel structure in addition to the salt tubes, specific breeding (F/sub net//M) is maximized at 33 vol% salt with a net fissile breeding ratio (F/sub net/) of 0.63, a tritium breeding ratio, T, of 1.06, and a blanket energy multiplication, M, of 1.91. The 6% excess in tritium breeding accounts for less than full blanket coverage and tritium decay. The initial estimate for this blanket concept was F/sub net/ = 0.6 and M = 1.6 at a salt volume fraction of 5%.

20250 **COVFILS-2: neutron data and covariances for sensitivity and uncertainty analysis.** Muir, D.W. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **52**: 301-302(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The author have prepared a new, fusion-oriented library of multigroup neutron cross sections, scattering matrices, and covariances (uncertainties and correlations). The 74-group library, called COVFILS-2, has been used, or will be used, by neutronics groups at Los Alamos National Lab. (LANL) at the University of California at Los Angeles, and at the Swiss Federal Institute for Reactor Research in the sensitivity and uncertainty analysis of fusion-relevant integral experiments such as the Li_2O experiment performed at the Fast Neutron Source Facility in Japan and the Lithium breeding module experiment planned at the LOTUS facility in Lausanne, Switzerland. Another intended use of this library is in the estimation of the uncertainty in key performance parameters (such as the breeding ratio) of conceptual fusion reactors. The 14 materials included in the first version of COVFILS-2 are hydrogen, ^6Li, ^7Li, beryllium, carbon, nitrogen, oxygen, sodium, aluminum, silicon, chromium, iron, nickel, and lead.

20251 **JAERI/US calculational benchmarks for nuclear data and codes intercomparison.** Youssef, M.; Jung, J.; Sawan, M.; Nakagawa, M.; Mori, T.; Kosako, T. (Univ. of California, Los Angeles). *Transactions of the American Nuclear Society;* **52**: 302-304(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Prior to analyzing the integral experiments performed at the Fast Neutron Source Facility at the Japan Atomic Energy Research Institute (JAERI), both US and JAERI analysts have agreed on four calculational benchmark problems proposed by JAERI to intercompare results based on various codes and data bases used independently by both countries. To compare codes, the same data base is used (ENDF/B-IV). To compare nuclear data libraries, common codes were applied. Some of the benchmarks chosen were geometrically simple and consisted of a single material to identify clearly sources of discrepancies and thus help in analyzing the integral experiments.

20252 **Breeder-in-tube design for a helium-cooled Li_2O tokamak blanket.** Billone, M.C.; Jung, J.; Liu, Y.Y.; Smith, D.L. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **52**: 329-330(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Of the solid breeder designs considered in the Blanket Comparison and Selection Study (BCSS), the lithium oxide breeder with helium coolant and ferritic steel (HT-9) structural material received

the highest overall ranking for both tokamak and tandem mirror systems in terms of engineering, economics, safety, and R & D requirements. The BCSS blanket surrounding the fusion plasma consists of a number of thin breeder plates externally cooled by flowing helium and internally purged of tritium by a separate helium stream. A detailed review of this design indicated that significant improvements would be realized in the areas of tritium breeding, blanket thickness, blanket energy multiplication, power-conversion efficiency, breeder temperature window, and geometrical integrity of the coolant and purge paths by using a neutron multiplier (beryllium), a higher temperature structural material (vanadium-based alloy), and a tube geometry. The neutronics, thermal-hydraulics, tritium recovery, and structural performance characteristics of this innovative solid breeder design are discussed in this paper.

20253 **Role of operating pressure in helium-cooled solid-breeder blanket designs.** Misra, B.; Billone, M.C. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* 52: 336-337(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

A review of the past design studies based on helium both as a heat transfer as well as a power conversion fluid was carried out to assess whether the overall power cycle efficiency can be improved by using coolant pressures significantly higher than those considered in some of the recent blanket design studies. An examination of the operating conditions that were selected for the high-temperature gas-cooled reactors and the gas-cooled fast reactors indicates that the design studies covered a wide spectrum of temperatures (up to 850°C) and pressures (up to 115 atm). The power conversion efficiency, however, depends more on the operating temperature than on the operating pressure, irrespective of whether one considers power conversion by direct cycle (via closed cycle gas turbines) or by a binary cycle (via steam turbines). The use of high pressures, which reduces the coolant velocity, leads to minimization of pumping power losses and adverse effects, such as flow-induced vibration, noise, and other motion-dependent phenomena. For the gas-cooled solid breeder blankets, the operating pressure has special significance. A higher operating pressure requiring thicker structures results in a lower breeder volume fraction for a fixed reactor design. This may lead to designs with an unacceptable tritium breeding ratio. The results summarized here are based on some of the above considerations.

20254 (CONF-870947—8) **Ray tracing in ATF using 3-D splines.** Goldfinger, R.C.; Batchelor, D.B. (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88000633/JAW.

From 12. conference on the numerical simulation of plasmas; San Francisco, CA, USA (20 Sep 1987).

The ray tracing code, RAYS, requires a subroutine module which supplies magnetic field and density as well as their gradients, to propagate rays using the cold plasma approximation. In order for the ray trajectory to remain a solution of the dispersion relation, $D(\omega,\text{anti }\kappa,\text{anti }r) = O$, the spatial derivatives of anti β and n/sub e/ numerically defined by the module must be a good approximation to the analytic derivatives of the field quantities themselves. This consistency, coupled with initializing the ray on a root of the dispersion relation, $D(\omega,\kappa_0,\text{anti }r_0) = O$, is sufficient for the ray to satisfy the dispersion relation along the ray. An additional requirement is that n/sub e/ be constant on a magnetic field line. Although this is not a necessary condition for the ray to satisfy the dispersion relation, the physics of the problem may dictate that this constraint be satisfied. The example of lower hybrid (LH) heating is described where this requirement should be satisfied in order to get meaningful results. A computationally efficient and robust way to solve these problems is to use 3-D cubic spline interpolation of a data set with the desired model for anti β and the accurate calculation of toroidal flux, PSI. The advantages and use of splines are the subject of this paper. 2 refs., 5 figs.

20255 (CONF-871007—83) **Measurements of electromagnetic properties of LCT [Large Coil Task] coils in IFSMTF [International Fusion Superconducting Magnet Test Facility].** Shen, S.S.; Baylor, L.R.; Dresner, L.; Fehling, D.T.; Lubell, M.S.; Lue, J.W.; Luton, J.N.; McManamy, T.J.; Wilson, C.T.; Wintenberg, R.E. (Oak Ridge National Lab., TN (USA); Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.); Japan Atomic Energy Research Inst., Tokai, Ibaraki; Swiss Inst. for Nuclear Research, Villigen). 1987. Contract AC05-84OR21400. 5p. NTIS, PC A02. Order Number DE88003774/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Participants in the international Large Coil Task (LCT) have designed, built, and tested six different toroidal field coils. Each coil has a 2.5- by 3.5-m, D-shaped bore and a current between 10 and 18 kA and is designed to demonstrate stable operation at 8 T, with a superimposed averaged pulsed field of 0.14 T in 1.0 s and simulated nuclear heating. Testing of the full six-coil toroidal array began early in 1986 and was successfully completed on September 3, 1987, in the International Fusion Superconducting Magnet Test Facility (IFSMTF) at Oak Ridge National Laboratory (ORNL). This paper summarizes electromagnetic properties of LCT coils measured in different modes of energization and fast dump. Effects of mutual coupling and induced eddy currents are analyzed and discussed. Measurements of the ac loss caused by the superimposed pulsed fields are summarized. Finally, the interpretation of the test results and their relevance to practical fusion are presented. 11 refs., 10 figs., 4 tab.

20256 (DOE/ER—0313/1, pp 75-79) **Activation of structural alloys in fusion reactor magnets.** Mann, F.M.; Doran, D.G. (Westinghouse Hanford Co., Richland, WA). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of the work is to calculate the short- and long-term activation of elements likely to be in the magnet region of a tokamak reactor. 6 refs., 2 tabs.

20257 (ENEA-RT-FUS—86-7, pp 29-33) **New concept in the design of high field toroidal magnets.** Sestero, A. (ENEA, Frascati, Italy. Centro Ricerche Energia). 1987. NTIS (US Sales Only), PC A06. Order Number DE87752631/JAW. (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

A new toroidal magnet concept is presented, aimed at producing very large, quasistationary magnetic fields without the help of an external press. Such a high performance is obtained by tilting the winding's turns by a proper amount off the meridian plane, which results in a number of favourable consequences.

20258 (ENEA-RT-FUS—86-7, pp 87-92) **Different manufacturing process of internal connections of toroidal coils.** Laurenti, A.; Biagiotti, B.; Danese, M.; Braccon, R.; Mori, L.; Hamelin, J.; Streibl, B.; Pizzuto, A.; Pratt, A.P. (ANSALDO SpA, Genoa, Italy; CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette, France; Max-Planck-Institut fuer Plasmaphysik, Garching, Germany, F.R.; ENEA, Frascati, Italy. Centro Ricerche Energia; UKAEA Culham Lab., Abingdon). 1987. NTIS (US Sales Only), PC A06. Order Number DE87752631/JAW. (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

The internal connections of toroidal coils are in general a critical problem the solution of which in the factory calls for great experience and the use of special instrumentation and methods which are defined and used only after carrying out many specific tests. ANSALDO's experience is today formed around the construction of four different types of toroidal coil which is a sufficiently varied and important selection; later these cases are described setting out the critical aspects, the operational modes and the tests used.

20259 (ENEA-RT-FUS—86-7, pp 93-98) **Manufacturing of the LN2 cooled toroidal coils of FTU.** Dal Mut, G.; Cimbrico, P.; Laurenti, A.; Broccon, R.; Baracco, R.; Mori, L.; Pizzuto, A.; Cecchini, A.; Crescenzi, C.; Di Pietro, E. (ANSALDO SpA, Genoa, Italy). 1987. NTIS (US Sales Only), PC A06. Order Number DE87752631/JAW. (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

The FTU Tokamak in order to reach the expected performance will have to operate at very high levels of magnetic fields for a large number of shots. The Toroidal Magnet will undergo very high stresses due to thermal and electromagnetic loads and provide the basic machanical structure supporting all the poloidal field windings and the vacuum vessel. The manufacturing of the magnet started on July '85 at the ANSALDO COMPONENTI works in Genova for delivery at the beginning of '87. The main manufactoring techniques and equipments used for construction, the insulation, the impregnation, the assembly and the mechanical tests are illustrated.

20260 (ENEA-RT-FUS—86-7, pp 99-105) **Design construction and test on a prototype of a poloidal coil of the FTU.** De Vellis, A.; Lovisetto, L.; Gasparotto, M.; Migliori, S.; Pizzuto, A.; Cimbrico, P.L.; Parodi, G.; Parodi, S.; Varni, G.; Curioni, S. (ENEA, Frascati, Italy. Centro Ricerche Energia; ANSALDO SpA, Genoa, Italy). 1987. NTIS (US Sales Only), PC A06. Order Number DE87752631/JAW. (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

The F.T.U. Tokamak, in order to produce the required performance, must be operated steadily at very high levels of the poloidal magnetic field and for a large number of shots (>10/sup 4/). In order to appraise the feasibility of these components a prototype of one poloidal coil has been manufactured and extensive mechanical, thermal and electrical tests at cryogenic temperature have been carried out. The main results are illustrated in succession.

20261 **(JAERI-M—87-133) Toroidal plasma MHD equilibrium code 'EQUCIR version 3'.** Shinya, Kichiro; Nishio, Satoshi. (Japan Atomic Energy Research Inst., Tokyo). Sep 1987. 21p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751976/JAW.

The "EQUCIR version 3" code has been developed by improving the freeboundary toroidal MHD equilibrium code "EQUCIR version 1 and 2". The central problems addressed by "EQUCIR version 3" are; 1) The magnetic flux distribution of a plasma at equilibrium is determined for a given external field. 2) A set of circuit equations between the plasma and the external conductors are constructed. These circuit equations and the Grad-Shafranov equation are solved self-consistently and the time evolution of plasma equilibria and currents in external conductors is also determined simultaneously. 3) The currents in the external conductors are determined so that the plasma cross-section and plasma parameters are to be maintained at the desired values. These equilibrium calculations are avilable for both limiter and divertor plasma configurations, with symmetric or asymmetric configurations. For reactor design analyses the following parameters were introduced for determining a more realistic poloidal coil current distribution. 1) A compromise parameter between the fidelity of the prescribed plasma shape and the PF coil total ampere-turms. 2) A weight function for securing the null-points in the prescribed positions for divertor plasmas. The effects of the above two parameters were checked quantitatively for the FER single null divertor plasma as an example. By selecting the appropriate values for these parameters, we could obtain a realistic plasma equilibrium and PF coil current distribution. A convergence property was also checked and no deterioration was observed.

20262 **(JAERI-M—87-153) Conceptual design study of fusion experimental reactor (FY86 FER). Magnet design.** Miki, Nobuharu; Iida, Fumio; Suzuki, Shohei; Wachi, Yoshihiro; Toyoda, Katsuyoshi; Hashizume, Takashi; Konno, Masayuki. (Japan Atomic Energy Research Inst., Tokyo). Sep 1987. 195p. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88751983/JAW.

This report summarizes the FER magnet design which was conducted last year (1986). Main objective of the new FER design is to have better cost performance of the machine. The physics assumptions are reviewed to reduce risks. Optimization of the physics design and improvements of the engineering design have been done without changing missions of the device. After a preliminary investigation for the optimization and improvements, six FER concepts have been developed to establish the improved design point, and have been studied in more detail. In the magnet design, the improvements of superconducting magnet design were mainly investigated to reduce the reactor size. A normal conductor was studied as an alternative option for appling to the special poloidal field coils that were located on the interior to the toroidal field coils. Some improvements were made on the superconducting magnet design. Based on the preliminary investigation, the magnet design specifications have been modified somewhat. The conceptual design of the magnet system components have been done for the candidate FER concepts.

20263 **(NIIEFA-P-B—0739) Specific features of numerical simulation of spatial magnetic fields of precision systems.** Dajkovskij, A.G.; Dojnikov, N.I.; Sychevskij, S.E. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1986. 12p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701522/JAW.

Characteristics of numerical simulation of space magnetostatic fields of the precision magnetic systems and application of a scalar potential are considered. An additional vector is determined in a local subregion of the calculation region; the subregion may be quite arbitrary to satisfy the requirements for increase of calculation accuracy, for simplicity of construction description, for decrease of operation number. The method of finite elements is used to obtain finite-difference equations. The results of numerical simulation of the space field of face parts of the dipole magnet with a complex form of a coil bend are given illustrating calculation accuracy. 14 refs.; 4 figs.

20264 **(NIIEFA-P-B—0740) Problem of development of the inductor for tokamak-type thermonuclear devices.** Dojnikov, N.I.; Sychevskij, S.E.; Filatov, O.G. (Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR)). 1986. 17p. (In Russian). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701523/JAW.

Questions concerning mathematical simulation of an inductor for tokamak-type thermonuclear devices are considered. Nonlinear inverse problem of magnetostatics is solved on the basis of regularization and integral method application. Calculation results for T-15 device are presented. 22 refs.; 3 figs.; 2 tabs.

20265 (ORNL—6332, pp 241-274) **Superconducting magnet development.** Oct 1987. NTIS, PC A19/MF A01. Order Number DE88003651/JAW.

In Fusion Energy Division annual progress report period ending December 31, 1986.

Major strides were made during 1986 in the performance of the international Large Coil Task (LCT) program of testing six different superconducting toroidal field coils. The six-coil test array, with a cold mass of 420,000 kg, was cooled to liquid helium temperature; each coil was tested to full design current and magnetic field (8 T); and testing in pulsed fields was begun. Operations and maintenance groups at the International Fusion Superconducting Magnet Test Facility overcame technical problems and achieved a high availability factor for the test facility over most of the year. Coil testing and analysis produced much valuable information. In all six coils, a high degree of quality assurance was achieved. All met LCT specifications, but tests elucidated significant differences, advantages, and disadvantages among the six designs and manufacturing techniques. International collaboration in the LCT work at ORNL continued to be quite effective.

20266 (UCID—21279) Contributions to the INTOR workshop. Miller, J.R. (comp.). (Lawrence Livermore National Lab., CA (USA)). 9 Dec 1987. Contract W-7405-ENG-48. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004149/JAW.

This paper discusses the use of Nb_3Sn conductors as coils for toroidal fields in thermonuclear reactors. In particular, the mechanical properties are investigated for these conductors as well as substitute materials. 8 refs.

20267 (UCRL—96862) TIBER-II TF [toroidal-field] winding pack design. Kerns, J.A.; Miller, J.R.; Slack, D.S.; Summers, L.T. (Lawrence Livermore National Lab., CA (USA)). 7 Oct 1987. Contract W-7405-ENG-48. 4p. (CONF-871007—84). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88004408/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The superconducting, toroidal-field (TF) coils in the Tokamak Ignition/Burn Engineering Reactor (TIBER II) are designed with cable-in-conduit conductor (CICC) using Nb_3Sn composite strands. To design the CICC winding pack, we used an optimization technique that maximizes the conductor stability without violating the constraints imposed by the structure, electrical insulation, quench protection, and fabrication technique. Detailed helium-properties codes calculate the heat removal along a flow path, and detailed field calculations determine the temperature, current, and stability margins. The conductor sheath is designed as distributed structure to partially support the combined in-plane and out-of-plane loads generated within the winding pack. Pancakes of the coil are wound, reacted, and insulated before being potted in the case. This design is aggressive but fully consistent with good engineering practice. 5 refs., 4 figs., 2 tabs.

20268 (UCRL—96864) High-field superconducting solenoids for the TIBER II PF [poloidal-field] system. Kerns, J.A.; Miller, J.R.; Summers, L.T. (Lawrence Livermore National Lab., CA (USA)). 7 Oct 1987. Contract W-7405-ENG-48. 4p. (CONF-871007—75). NTIS, PC A02. Order Number DE88004400/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The poloidal-field (PF) coil set for the Tokamak Ignition/Burn Engineering Reactor (TIBER-II) consists of 24 solenoid modules, 16 of which are stacked inside the toroidal-field (TF) system at the center of the machine. These central solenoid modules operate at high-current densities, and maximum fields at the windings approach 14 T. Although TIBER-II is designed for steady-state operation with noninductive current drive, other operating scenarios are also considered. In the pulsed or inductive mode, PF coil currents are ramped to induce plasma current. In this mode, peak fields approaching 14 T appear on the central solenoid modules at the ends of the stack; the required current densities in these modules approach 40 A . mm^2. The central solenoid modules are layer wound using cable-in-conduit conductor (CICC) with $(NbTi)_3Sn$ composite strands for improved high-field performance. Layer winding permits grading the conductor for maximum overall winding-pack current density and also results in less wasted space in the radial build of the machine. Cooling connections may be made at each layer of a module as needed. Current leads to the modules are routed through the high-field central bore. The central solenoid modules can easily support the centering load of the PF system, reducing the overall radial build of the machine and greatly increasing the limit on the number of pulse cycles imposed by fatigue considerations in the central solenoid. 5 refs., 3 figs., 2 tabs.

20269 (UCRL—96866) Cable-in-conduit conductor optimization for fusion magnet applications. Miller, J.R.; Kerns, J.A. (Lawrence Livermore National Lab., CA (USA)). 7 Oct 1987. Contract W-7405-ENG-48. 7p. (CONF-871007—80). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004361/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Careful design of the toroidal-field (TF) and poloidal-field (PF) coils in a tokamak machine using cable-in-conduit conductors (CICC) can result in quite high overall winding-pack current densities - even with the high nuclear heat loads that may be imposed in operating a fusion reactor - and thereby help reduce the overall machine size. In our design process, we systematically examined the operational environment of a magnet, e.g., mechanical stresses, current, field, heat load, coolant temperature, and cooldown stresses, to determine the optimum amounts of copper, superconductor, helium, and sheath material for the CICC. This process is being used to design the superconducting magnet systems that comprise the Tokamak Ignition/Burn Experimental Reactor (TIBER II). 13 refs., 2 figs.

20270 Super high field tokamaks: Experiments and reactors. Cohn, D.R.; Bromberg, L. (M.I.T. Plasma Fusion Center, Cambridge, MA 02139). pp 2 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Recent experimental results in tokamaks together with advances in magnet technology suggest the use of super high fields in large aspect ratio devices and consideration of superconducting as well as copper magnets. Super high field copper magnet devices would use magnetic fields of 13 to 25 T at the plasma axis. Advances in superconducting magnet technology could provide fields of 8 - 13 T in concepts for super high field ETR devices and commercial reactors. An effective way to achieve burning plasma conditions may be to use pure ohmic or ohmic dominated heating. The ohmic heating contribution and ntau/sub e/ value projected for ohmically heated plasmas by "Neo-Alcator" scaling could both be maximized by designs with the highest possible values of B/sup 2/a (where B is the magnet field and a is the minor radius). B/sup 2/a is generally maximized by use of a high aspect ratio, increasing the magnet field at the expense of minor radius. The use of high aspect ratio facilitates high values of magnetic field at the coil since there is more area in the inner leg of the TF magnet to keep the stresses and magnet heating at acceptable values.

20271 Review of stellarator research world wide. Shonet, J.L. (Torsatron/Stellarator Lab., Univ. of Wisconsin, Madison, WI 53706). pp 3-4 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The world-wide effort in stellarators has evolved considerably during the past few years. Stellarator facilities are located in the Australia, Federal Republic of Germany, Japan, the Soviet Union, Spain, the United Kingdom and the United States. Dimensions of stellarators range from less than 20 centimeters in major radius to more than 2 meters, and magnetic field values between 0.2 Tesla to more than 3.0 Tesla. Stellarators are made in a variety of magnetic configurations with wide ranges of toroidal aspect ratios and methods of generating the stellarator magnetic surfaces. In particular, continuous helical coils, twisted modular coils, or twisted vacuum chambers all provide different means to generate nested toroidal magnetic surfaces without the need for currents flowing in the plasma. The goal of present day experiments is to accumulate a physics data base. This is being done by increasing electron and ion temperatures with non-ohmic heating, by transport and scaling studies considering neoclassical scaling, global scaling, effects of electric fields, the bootstrap current and magnetic islands. Higher betas are being attempted by designing suitable magnetic configurations, pellet injection and/or minimizing transport losses. Plasma-wall interactions and particle control are being examined by divertor, pumped-limiter and carbonization experiments.

20272 Stability of tokamak-stellarator hybrid plasmas. Choe, W.H. (Univ. of Illinois, Urbana-Champaign). pp 4 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

One of the most important advantages of the tokamak-stellarator hybrid concept is the capability of producing a variety of new attractive magnetic configurations. In the present work, the authors examine the MHD stability of hybrid plasmas in an attempt to explore the possibility of improving reactor prospects of the pure tokamak concept. A computer code has been written for sharp boundary calculation of configurations with two helical harmonics superimposed on a tokamak. The study is restricted to the surface current model, where it is assumed that all the current flows in a thin sheath forming the boundary between plasma and vacuum. It is well-known from previous experience that the sharp boundary model gives a reasonable description of plasma stability against low-n MHD modes. The equilibrium calculation is based on the Princeton's stellarator expansion, and the computed equilibrium solutions are tested for stability by a means of the MHD energy principle. The main part of this work is analytical both in the equilibrium and the stability calculations, resulting in simple reduced equations. The reduced equations are then solved numerically to find out beta limits for systems with a combination of two helical harmonics.

20273 **TFTR poloidal coil fault analysis.** Pelovitz, M. (Princeton Univ., NJ). *Transactions of the American Nuclear Society;* **52**: 235(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

A problem that arose in Tokamak Fusion Test Reactor (TFTR) operations near the end of 1984 was that the time required to build the plasma current up to high levels was longer than anticipated, requiring more volt-seconds to overcome the plasma power dissipation. To remedy this problem, it was decided to drive the ohmic heating (OH) system at 24 kA instead of the design value of 20 kA in mode B. Precautionary fault analyses had to be made before machine operation could be attempted at these levels to lessen the possibility of a coil failure since such a failure would have been catastrophic. Additionally, the time schedule called for a prolonged shutdown within a 12-week period from the time this study was undertaken, and it was desired to perform these experimental runs before the shutdown; therefore the study had to be completed several weeks before this shutdown.

20274 **Testing electrical insulation of LCT coils and instrumentation.** Luton, J.N.; Ellis, J.F.; Ulbricht, A.R. (Oak Ridge National Lab., TN, USA; Kernforschungszentrum Karlsruhe G.m.b.H., Germany, F.R.). pp 1741-1748 of Fusion technology 1986. Proceedings of the fourteenth symposium, Avignon, France, 8-12 September 1986. In two volumes. Oxford, England; Pergamon Press (1986). (EUR—10936-EN; CONF-860917—). Contract AC05-84OR21400.

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

Three of the superconducting test coils in the Large Coil Task (LCT) use conductors cooled internally by forced flow of helium. In the other three coils, the conductors are cooled externally by a bath of helium. The coils and facility are designed for rapid discharges (dumps) at voltages up to 2.5 kV, depending on coil design. Many coil sensors are connected electrically to the conductors. These sensor leads and signal conditioning equipment also experience high voltage. High-potential tests of ground insulation were performed on all components of the International Fusion Superconducting Magnet Test Facility (IFSMTF). Coil insulation was also tested by ring-down tests that produced voltage distributions within the coils like those occurring during rapid discharge. Methods were developed to localize problem areas and to eliminate them. The effect on breakdown voltage near the Paschen minimum of magnetic fields up to 2 T was investigated.

20275 **Experience with cooldown of superconducting magnet coils in the Large Coil Task.** Haubenreich, P.N.; Fietz, W.A.; Ellis, J.F. (Oak Ridge National Lab., TN, USA). pp 1803-1809 of Fusion technology 1986. Proceedings of the fourteenth symposium, Avignon, France, 8-12 September 1986. In two volumes. Oxford, England; Pergamon Press (1986). (EUR—10936-EN; CONF-860917—). Contract AC05-84OR21400.

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

Six superconducting toroidal field coils have been tested in the Large Coil Task. In three coils, conductors are bath cooled. Three have conductors cooled by internal flow of helium. Coils provided by JAERI and EURATOM were cooled first in single-coil facilities at Naka and Karlsruhe. In the International Fusion Superconducting Magnet Test Facility (IFSMTF) at Oak Ridge, the 420,000-kg, six-coil array was successfully cooled to operating temperature early in 1986. Analysis of the IFSMTF data and comparison with cooldown of magnets in other facilities provided better understanding of massive, multicomponent arrays.

20276 **High-field superconducting magnets (12 T and greater) for fusion applications.** Miller, J.R.; Summers, L.T.; Kerns, J.A. (Lawrence Livermore National Lab., CA). *Transactions of the American Nuclear Society;* **52**: 310(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Our ability to produce high magnetic fields in large volumes using superconducting windings has grown dramatically in recent years. The coils in the International Fusion Superconducting Magnet Test Facility at Oak Ridge National Lab. soon will have produced 8 T in a toroidal array of six D-shaped coils appropriate for a tokamak and ~ 10 tonnes each. One of the nearly 400-tonne Yin-Yang pairs in Magnetic Fusion Test Facility-B at Lawrence Livermore National Lab. (LLNL) has already produced fields near 7.7 T, and soon the rest of the coils will be charged, with fields in the choke coils of this linear array exceeding 12 T.

20277 **Computer-aided inductance calculation for high current power transmission lines.** Nudelman, A. (Princeton Plasma Physics Lab., NJ). *Transactions of the American Nuclear Society;* **52**: 316-317(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

With the use of high-power pulsed power supplies in magnetic and inertial fusion machines, the inductance of transmission lines becomes increasingly important. Considering the current range of several hundred to several thousand amperes and the high cost of the transmission lines, it is necessary to determine their properties in the early stage of design. The inductance calculations are relatively simple for strictly symmetrical wire configurations where each wire carries equal current. However, for asymmetrical wire configurations commonly used in transmission lines with more than 10 wires, the existing methods become impractical. In this paper, a computer-aided calculation method is presented based on general circuit theory and applicable to any practically employed transmission line consisting of parallel connected wires. The calculation is based on solving a system of simultaneous linear equations related to the number of circuit components. The limiting factor is the computer's matrix inversion ability.

20278 (ENEA-RT-FUS—86-7, pp 47-52) **FTU power supply system. Final design.** Coletti, A.; Coletti, R.; Valente, F. (ENEA, Frascati, Italy. Centro Ricerche Energia). 1987. NTIS (US Sales Only), PC A06. Order Number DE87752631/JAW. (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

The FTU poloidal and toroidal field systems will be supply by two motor-flywheel-generators sets and several thyristor converters for total 660 MW DC power. The paper shows the main features of the final design.

20279 (IA—1427, pp 56) **Continuous wave operation of multiply doped Ho:YLF and Ho:YAG lasers.** Kalisky, Y.; Kagan, J.; Sagie, D.; Lotem, H. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

20280 (IA—1427, pp 56) **Temporal and spatial properties of an oscillator-amplifier copper vapor laser.** Amit, M.; Lavi, S.; Erez, G.; Miron, E. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

20281 (IA—1427, pp 56) **Magnetic pulse compression for copper vapor laser.** Kramer, Z.; Nehmadi, M.; Ifrah, Y.; Miron, E. (Israel Atomic Energy Commission, Tel Aviv). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

20282 (JAERI-M—87-144) **Conceptual design study of fusion experimental reactor (FY86FER). Power supply design.** Nakashima, Kunihiko; Ishigaki, Yukio; Ozaki, Akira; Yamane, Minoru. (Japan Atomic Energy Research Inst., Tokyo). Sep 1987. 116p. (In Japanese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751979/JAW.

This report describes the results of the capacity estimation for the electrical power system on the typical two candidates for the FER (Fusion Experimental Reactor) which were picked out through the process of '86 FER scoping studies. Main concern in the electrical systems is coil power supplies which have a capacity of about 1 GW, and this is dominated by poloidal coil power supplies. Then, studies to reduce the converter capacity are concentrated on the poloidal coil power system in relation to the sypplying poloidal flux at the initial phase of plasma ramp-up. A quench protection circuit was proposed on the toroidal coil power supply. On the position control power supply, a circuit with reasonable functions was proposed. Under these system studies, general specifications were determined and the capacity of each power supply unit was estimated. On the poloidal coil power supply system, the accumulated capacity of converters amounted to 885 MW for the one candidate and 782 MW for another.

20283 (ORNL/TM—10620) **Optimum transformer design for a pulsed power system.** Broverman, A.Y. (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 20p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88006054/JAW.

Electromagnetic forces resulting from peak pulsed current require special design consideration to prevent failure of the coils of the transformer. Procedures for interleaving transformer windings to reduce both electromagnetic short-circuit forces and reactive voltage drop while reducing procurement costs are described. The basics of transformer design principles and cost trade-offs are included to enhance understanding of the interleaving procedures. 3 refs., 3 figs.

20284 **Description of the heliac TJ-II and its ECRH system.** Perea, A.; Martin, R.; Alvarez Rivas, J.L.; Botija, J.; Cepero, J.R.; Fabregas, J.A.; Guasp, J.; Lopez Fraguas, A.; Perez-Navarro, A.; Carreras, B.A. (Oak Ridge National Lab., Oak Ridge, TN). pp 673-678 of Fusion technology 1986. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

This paper describes the main engineering aspects of the flexible heliac TJ-II, as well as the ECRH scheme that will be used for initial operation.

20285 **Current requirements for ohmic ignition in OHTE and RFP reactors.** Scardovelli, R.A.; Hu, S.C.; Miley, G.H. (Fusion Studies Lab., Univ. of Illinois, 103 South Goodwin Avenue, Urbana, IL 61801). pp 381-386 of Fusion technology 1986. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

A zero-dimensional power balance code is used to determine the minimum current requirements for ohmic ignition in compact and large OHTE and RFP reactors. It is shown that ignition must be reached through a range of densities (the density "window") where the width of the window is a strong function of the current employed.

20286 **Sequential control of TFTR power supplies.** (Plasma Physics Lab., Princeton Univ., Princeton, NJ 08544). pp 891-896 of Fusion technology 1986. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

The design of the TFTR power supplies and their control infrastructure provides a maximum of flexibility in terms of control strategy options. Utilizing this inherent flexibility two types of sequential control have been developed. The first, which is presently operational in the Toroidal Field (TF) system, is designed to optimize power factor while permitting two quadrant rectifier operation. The second, which is presently under development and will be used for the TF and Ohmic Heating (OH) systems, is designed to optimize both power factor and distribution of thermal loading while permitting single quadrant rectifier operation only. With these control methods the ultimate capability of the TFTR power supply system is made available.

20287 **Hybrid Z-Θ Pinches with fused capacitor banks.** Grandey, R.; Gersten, M.; Loter, N.; Rauch, J.; Rostoker, N.; Thompson, W.; Ware, K. (Maxwell Labs., Inc.). pp 16-17 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The Hybrid Z-Θ Pinch circuit equations in the thin shell model were reexamined to see what advantages can be obtained by using a fused, high-energy (>—1MJ) bank driver. The DNA ACE facility at MLI utilizes a 36 μF capacitor band which can be charged to 120 kV to provide 250 kJ of stored energy. This configuration appears to be very appropriate to test the performance of a hybrid-stabilized fused-bank driven pinch. The circuit analyses suggest that the energy transfer efficiency from the bank to a pinched plasma can be increased from less than 1%, for a nonfused bank, to about 10% for a fused configuration. In the applicable region of parameter space, the Hybrid Pinch does not increase the efficiency of energy transfer into the plasma over that obtainable from a Z-pinch. The additional stability may allow larger initial radii to be used with concomitant improved coupling into radiation above 1 keV.

20288 **New directions for short-wavelength laser fusion and high-energy-density physics.** Mc Crory, R.L.; Soures, J.M.; Goldman, L.; Richardson, M.; Seka, W.; Simon, A.; Skupsky, S.; Verdon, C.; Yaakobi, B. (Lab. for Laser Energetics, Univ. of Rochester, 250 East River Road, Rochester, NY 14623-1299). pp 204-245 of Twenty years of plasma physics. Mc Namara, B. Teaneck, NJ; World Scientific Pub. Co. (1985). (CONF-840932—).

From Meeting on plasma physics; Trieste, Italy (24 Sep 1984).

New directions in inertial fusion research using short-wavelength, direct-drive targets have increased the prospects for demonstrating inertial fusion feasibility and have generated new interest and opportunities in high-energy research.

20289 **Local radiative cooling of edge plasmas by intense neutral gas puffing.** Prinja, A.K.; Zweben, S.J. (Univ. of New Mexico, Dept. of Chemical and Nuclear Engineering, Albuquerque, NM 87131). *Fujitsu Scientific and Technical Journal;* **12**: No. 3, 428-436(Nov 1987).

It is proposed that the overheating of tokamak limiters can be controlled by introducing a strong local source of neutral H/sub 2/ directly at that limiter to convert the incident particle energy into isotropic radiation. The neutral influx rate required to substantially reduce the heat flux to the limiter is calculated as a function of the incident plasma parameters using a simplified one-dimensional fluid model. Application of this scheme to large tokamaks is discussed.

20290 LN_2 cyclic cooling considerations of fusion ignition devices. Dabiri, A.E. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **52**: 138-139(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The purpose of this study is to develop a simple model to calculate the cooldown rate of a magnet with various cooling surface configurations. The results will be useful in developing a configuration to provide the desired cooling time between pulses, which should be ~ 1 h or less. The preliminary results indicate that the cooldown time between pulses is ~ 1 to 2 h, thus limiting the number of pulses to four to eight per day. A shorter cooldown time is feasible by increasing the cooling surface area. The inner leg radial dimension should be increased to obtain a larger cooling surface area for the fixed ratio of cooling channel-to-inner leg cross section. This will directly impact the capital cost of the device.

20291 Liquid-lithium nitrate: candidate fusion reactor coolant or chemical curiosity. Adamson, M.G. (Lawrence Livermore National Lab., CA). *Transactions of the American Nuclear Society;* **52**: 219-220(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

On the basis of the recent Blanket Comparison and Selection Study, 700 K was selected as the threshold for useful high-temperature operation of a liquid nitrate coolant and 800 K was assumed as a realistic upper operating limit. Both standard Second Law equilibrium calculations and computerized Gibbs energy minimization methods were used to determine equilibrium compositions of multiphase, multicomponent salt systems at specified temperatures under certain condensed were performed on the $LiNO_3$-$LiNO_2$, $NaNO_3$-$NaNO_2$, and KNO_3-KNO_2 systems, and then predicted decomposition pressures were compared for equivalent degrees of decomposition at temperatures ranging from 600 to 900K. Two approaches were taken in calculating decomposition pressures over MNO_3-MNO_2 systems: (a) allowing the formation of molecular N_2 as a gaseous reaction product and (b) not allowing its formation. In calculations of MNO_2-M_2O-MOH-H_2O equilibria, which were used to evaluate the reversibility of tritium dissolution and release, the activity of hydroxide reaction product was determined as a function of water activity at two representative temperatures. Preliminary results and conclusions are summarized.

20292 (AD-A—185903/2/XAB) Advanced fusion power; a preliminary assessment. Final report, 1986-1987. Miley, G.H.; Berk, H.L.; Cartwright, D.C.; Christy, R.F.; Hoffman, N.J. (National Research Council, Washington, DC (USA)). Oct 1987. 56p. NTIS, PC A04/MF A01.

This report reviews research and studies of fusion with low neutron emission and advanced fuels (such as deuterium with helium 3); it assesses the feasibility of developing advanced fuels as a fusion power source for space propulsion and electrical power generation.

20293 (CEA-CONF—9061) Tritium extraction mechanisms from lithium aluminates during in pile irradiation experiments. Briec, M.; Roth, E. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). Apr 1987. 31p. (CONF-8704245—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751348/JAW.

From Workshop on tritium modelling; Chalk River, Canada (23 Apr 1987).

The principal aim was to determine ranges of parameters governing tritium release from γ lithium aluminates within which acceptable rates for their contemplated usage as tritium breeder material in a fusion reactor blanket could be obtained. in the first place values of every quantity involved should be known as well as possible. Reproducible results should be a criterium of validity of the selected parameters. It is shown from a description of a series of experiments that processes limiting tritium release rates are not the same in different temperature ranges. By varying the composition of purge gases used for tritium extraction, the level of irradiation fluxes, and by studying simultaneously samples of different textures, results were obtained and an assignment of the respective role of defect formation, texture, surface effect is attempted to interpret them.

20294 (CEA-CONF—9062) Tritium release behaviour from lithium aluminate ceramics. Botter, F.; Cherquitte, D.; Mougin, J.; Roth, E.; Bonal, J.P.; Briec, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie). Apr 1987. 22p. (CONF-8604378—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751349/JAW.

From Symposium on fabrication and properties of lithium ceramics; Pittsburgh, PA, USA (26 Apr 1986).

Out-of-pile experiments succeeding short irradiations were proposed first with the aim of exploring significant parameters of the release process, in order to orient the longer, and much more effort consuming, in situ release trials. They also provide a means of investigating the mechanism and kinetics of this release. In this study results of out-of-pile experiments will be compared with inpile tritium extractions performed on samples of similar texture. The study deals also with the analysis, after irradiation, of helium and tritium from a sample irradiated during the ALICE I experiment. Simultaneous helium and tritium release studies help to throw light on helium and tritium extraction mechanisms of these two element from the solids.

20295 (CEA-CONF—9168) Optimization of slow wave multijunction antennae for current drive. Moreau, D.; David, C.; Gormezano, C. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). May 1987. 6p. (CONF-870570—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751845/JAW.

From 7. topical conference on applications of radio-frequency power to plasmas; Kissimmee, FL, USA (4 May 1987).

Having defined a directivity parameter based on current drive efficiency we quantitatively compare various n/sub /// spectra which can be launched by a multijunction coupler. We show how such couplers can be optimized on the basis of linear coupling theory by choosing the locations of the E-plane junctions.

20296 (CONF-871179—9-Vugraphs) Benchmarks of neutral beam injection codes for stellarators. Fowler, R.H.; Rome, J.A.; Morris, R.N.; Hanatani, K. (Oak Ridge National Lab., TN (USA); Kyoto Univ., Uji (Japan). Plasma Physics Lab.). 1987. Contract AC05-84OR21400. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003786/JAW.

From US/Japan heliotron-stellarator workshop; Oak Ridge, TN, USA (9 Nov 1987).

The 3-dimensional geometry of stellarators/heliotrons make it more difficult to calculate beam deposition and thermalization. Extensive comparisons between the Oak Ridge and Kyoto codes were undertaken, using a simplified model for the Heliotron-E plasma and magnetic field. The perpendicular injection geometry causes most of the energetic fast ions to be helically trapped. The high transform and shear of the heliotron configuration helps to confine these orbits, but energy losses in the model cases ranged from 20 to 50%. Although the codes use different coordinate systems and collision operators, when they solve the same problem, the answers are equivalent. For perpendicular injection, very little, if any, acceleration of the slowing process can be tolerated.

20297 (CONF-880151—1-Vugraphs) CIT [Compact Ignition Tokamak] fueling. Houlberg, W.A. (Oak Ridge National Lab., TN (USA)). 1988. Contract AC05-84OR21400. 21p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002709/JAW.

From CIT conceptual design review conference; Princeton, NJ, USA (19 Jan 1988).

A series of viewgraphs present issues related to the conceptual design of the Compact Ignition Tokamak. The presentation includes discussions of fueling issues, pellet injector technology, pellet ablation and penetration, particle confinement, and fueling scenarios. The author concludes that existing technology should be used for the basic injector while several options for enhanced ve-

locity injectors are under development; adequate models exist for pellet ablation; and improvements in confinement models can come from the TFTR and JET programs. (DWL)

20298 (DOE/ER—0313/1, pp 376-379) **Time dependent analysis of in situ tritium release curves from the VOM-22H experiment.** Hollenberg, G.W.; Kurasawa, T.; Watanabe, H.; Ishii, Y. (Westinghouse Hanford Co., Richland, WA; Japan Atomic Energy Research Institute, Tokyo). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The use of a time dependent method of diffusional analysis for in situ tritium recovery data provides advantages over the inventory method, providing the measurements are sufficiently precise. The size of an ionization chamber directly affects the time dependence of its output with smaller chambers having less of an impact. 4 refs., 3 figs.

20299 (DOE/ER/52111—T2) **Application of railgun principle to high-velocity hydrogen pellet injection for magnetic fusion reactor refueling: Technical progress report.** Kim, Kyekyoon (Kevin). (Illinois Univ., Urbana (USA). Fusion Technology Lab.). Dec 1987. Contract FG02-84ER52111. 110p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005830/JAW.

This paper discusses the use of a railgun accelerator to inject hydrogen pellets into a magnetic fusion reactor for refueling purposes. Specific studies in this paper include: 1.5 mm-diameter two-stage fuseless plasma-arc-driven electromagnetic railgun, construction and testing of a 3.2 mm-diameter two-stage railgun and a theoretical analysis of the behavior of a railgun plasma-arc armature inside a railgun. (LSP)

20300 (ENEA-RT-FUS—86-7, pp 59-64) **Technological problems and salutations for the FTU LH RH system.** Andreani, R.; Mirizzi, F.; Sassi, M. (ENEA, Frascati, Italy. Centro Ricerche Energia). 1987. NTIS (US Sales Only), PC A06. Order Number DE87752631/JAW. (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

The lower hybrid, electron mode, additional heating system (LHRH) for the Frascati Tokamak Upgrade (FTU), is designed to inject 8 MW, 1 se, radiofrequency power pulses at 8 GHz into the plasma. The system is composed by eight identical modules, each one delivering 1 MW of RF power to the plasma through an antenna cosisting of two 8*8 rectangular waveguides grills. Gyrotrons have been chosen as the most suitable generators to have large unit power (500 kW) and good performances in presence of high load VSWR. Technological problems arise from the RF coupling structures because of the high frequency of operation increases the complexity of the system and requires the development of small size copper-stainless steel coextruded waveguides with single ceramic window inside.

20301 (EUR-CEA-FC—1326) **New type of coupler for current generation and heating by hybrid waves on large tokamaks.** Briffod, G.; Nguyen, T.K. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. de Recherches sur la Fusion Controlee). Apr 1987. 22p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751850/JAW.

The use of multijunction grill type waveguide is a solution to coupling of hybrid waves to plasma in the large tokamak cases. This solution is discussed. A new solution of power supply of waveguides is also proposed to avoid difficulties and to keep the control field of the conventional grill spectra. Application to jet is discussed.

20302 (FR-CEA-TH—40) **Measurements after irradiation of helium and tritium residual puantities in lithium aluminate (γLiAlO/sub 2/).** Bonal, J.P. (Conservatoire National des Arts et Metiers (CNAM), 75 - Paris (France); CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Technologie). Jul 1987. 239p. (In French). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88751854/JAW.

Heating between 930/sup O/C and 1000/sup O/C, under vacuum or in a sweeping gas, of irradiated γLiAlO/sub 2/ samples allows extraction of the whole residual tritium and helium. The chemical species released by irradiated γAlLiO/sub 2/ is principally tritiated water. Nevertheless, if ceramics are placed in stainless steel, the residual tritium fraction in tritiated water form decreases when irradiation temperature increases between 250/sup O/C and 520/sup 0/C. The more important factors in tritium retention are irradiation temperature and nature of the can material. Residual tritium amount decreases when irradiation temperature increases between 250/sup O/C and 520/sup O/C. Beyond 500/sup O/C, surface desorption phenomena are important. Retention of helium 4 is weak and not much dependent of irradiation temperature. Residual helium 4 fraction is weaker in big grain samples than in small grain samples. At 975/sup O/C, helium 4 release is controlled by diffusion phenomena.

20303 (GA-A—18892) **Doublet III Neutral Beam Heating Project: Final report for the period FY78 through FY81.** Colleraine, A. (GA Technologies, Inc., San Diego, CA (USA)). May 1987. Contract AT03-78ET51018. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004156/JAW.

The Neutral Beam Project final scope of work consisted of procurement, fabrication, assembly, test, and installation of two neutral beam injection systems for the DIII machine. One of these NBIS was installed and operated at the 210° location; the second was placed at the 330° location. The Doublet III Neutral Beam Administrative Plan defined the technical, cost, and schedule requirements necessary to achieve the program objectives. These requirements are presented in the form of Baseline Definitions: Technical, Cost, Schedule which are contained in this Administrative Plan. These Baselines formed the basis for control of not only the overall program but of each major participant. GA, LBL, and TRW were assigned specific scopes of work within the Baselines to be accomplished in order to meet the overall program objectives. To accomplish these work scopes, GA, LBL, and TRW each established within their own project organization, a system for controlling and accomplishing work which is compatible with and complementary to the overall management system at GA. 21 figs., 5 tabs.

20304 (IAEA-TECDOC—441, pp 43-44) **Current drive requirements for INTOR/ETR.** Ehst, D.A. (Argonne National Lab., IL, USA). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

20305 (IAEA-TECDOC—441, pp 45-48) **Comparison of NBI current drive theory with experiment and the requirements for extrapolation to next step devices.** Okano, K.; Masuzawa, M.; Yamamoto, S.; Sugihara, M.; Fujisawa, N. (Toshiba Corp., Kawasaki, Kanagawa, Japan. Research and Development Center; Japan Atomic Energy Research Inst., Ibaraki). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

20306 (IAEA-TECDOC—441, pp 49-51) **Driver power reduction in beam driven steady state tokamaks by appropriate plasma shaping.** Okano, K.; Shinya, K.; Yamato, H. (Toshiba Corp., Kawasaki, Kanagawa, Japan. Research and Development Center). Nov 1987. NTIS (US Sales Only), PC A08/MF A01. Order Number DE88701295/JAW. (CONF-860995—; CONF-8509441—; CONF-8611218—; CONF-8606376—).

From IAEA specialists' meeting on noninductive current drive; Garching, F.R. Germany (15 Sep 1986).

20307 **(JAERI-M—87-113) Review of JT-60 experimental results from January to March, 1987.** (Japan Atomic Energy Research Inst., Tokyo). Aug 1987. 288p. (In Japanese). NTIS (US Sales Only), PC A13/MF A01. Order Number DE88751973/JAW.

This is a prompt report on JT-60 experimental results from January to March, 1987. Maximum LHRF injection power of 6.3 MW was achieved by using 3 launchers. The correlation between flattening of plasma current profile and energy confinement improvement was demonstrated by controlling N/sub 11/ spectrum of current drive and heating launchers. The maximum electron temperature of 6 kW was achieved with 2.4 MW LH injection in electron heating mode. Non-inductive driven current of 2 MA with 2.5 sec duration was demonstrated with 3 MW LHRF injection. Substantial acceleration of NB injected fast ions up to 160 kW was observed during ICRF + NB (60 keV) injection. In low density high power NB injected limiter discharges, high ion temperature of ~ 11 keV and electron temperature of 5 keV were obtained with Z/ sub eff/ = 5. Various attempts were made to produce H-mode in divertor and limiter discharges.

20308 **(JAERI-M—87-145) Conceptual design study of fusion experimental reactor (FY86FER). NBI heating and current drive system design.** Nakashima, Kunihiko; Yamamoto, Shin; Ohara, Yoshihiro; Watanabe, Kazuhiro; Mizuno, Makoto; Araki, Masanori; Uede, Taisei; Okano, Kunihiko. (Japan Atomic Energy Research Inst., Tokyo). Sep 1987. 93p. (In Japanese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751980/JAW.

This report describes the results of applicability studies for the negative ion-based neutral beam injector to the Fusion Experimental Reactor (FER). The operation scenario of FER has been proposed to adopt the neutral injection method as one of candidates, which has three functions of heating, current drive and profile control. One of the fundamental requirements is the tangential injection of the neutral beam. For neutral beam injectors, three port sections are available. Supposing to adopt the beam line with the straight long neutralizer which has been designed in JAERI, the geometrical arrangement was determined so as to avoid any trouble to the reactor structure. The conceptual study for major components which compose the beam line system was carried out including the estimation of the neutron streaming. The power supply system was studied also and the work was concentrated on the acceleration power supply which requires the output voltage of 500 kV and fast cut-off time. A basic concept, in which a inverter with a AC switch is used and the frequency of the supplied AC line is increased was proposed. In these works, the configuration of the neutral beam injection system was detailed and it was shown that the beam line seems to be well implemented with the geometrical constraints related to the reactor configuration.

20309 **(JAERI-M—87-159) Improvement of confinement in auxiliary-heated (ICRF) divertor discharges by pellet injection.** Kasai, Satoshi; Miura, Yukitoshi; Sengoku, Seio. (Japan Atomic Energy Research Inst., Tokyo). Oct 1987. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751987/JAW.

An improvement of plasma confinement by pellet injection was investigated in ion cyclotron range of frequency (ICRF) wave heated plasmas with a single null divertor configuration on JFT-2M. Pellets were injected into the L- and H-modes of the ICRF heated plasmas. Global energy confinement time (tau/sub E/) was drastically improved in both modes. Such an improvement by the pellet fueling in the H-mode could not be achieved in the neutral beam (NB) heated plasmas. Line averaged electron density of 6 x 10/sup 19/ m/sup -3/ (Δn-bar/sub e/ = 3 x 10/sup 19/ m/sup -3/) obtained by the pellet fueling was maintained for about 100 ms, so it is considered that particle confinement is improved. Radiation loss was not large in the pellet fueled discharges.

20310 **(JAERI-M—87-161) Review: study of single-pellet injection experiments and development of pellet injector in JFT-2M.** Kasai, Satoshi; Miura, Yukitoshi; Hasegawa, Kouichi; Sengoku, Seio. (Japan Atomic Energy Research Inst., Tokyo). Oct 1987. 58p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751989/JAW.

The single pellet injector developed for JFT-2M and the improvement of plasma characteristics in the auxiliary-heated discharges by single-pellet injection are reviewed for the period 1982 - 1986. The pellet injector is a pneumatic type and the designed pellet size is 1.65 mmD x 1.65 mmL and 1 mmD x 1 mmL. The hydrogen, deuterium and mixed (H/sub 2/ + D/sub 2/) pellets can be produced with good reproducibility. Maximum pellet velocity is about 970 m/s (pellet is deuterium and propellant gas is hydrogen). In the pellet injection experiments into auxiliary-heated (NB, ICRF) divertor or limiter discharges, the plasma confinement time is improved by a factor of 1.4 - 1.7 compared with the confinement time in the Ohmic discharges. The achieved confinement time is longer than that on the high confinement mode (H-mode) in gas fueled discharges, although the phenomena are transient.

20311 **(JAERI-M—87-162) Production and injection of hydrogen-deuterium mixed pellet.** Hasegawa, Kouichi; Kasai, Satoshi; Miura, Yukitoshi; Ishibori, Ikuo. (Japan Atomic Energy Research Inst., Tokyo). Oct 1987. 15p. (In Japanese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751990/JAW.

A mixed solid pellet of hydrogen and deuterium could be produced in the single pellet injector. The pellet is used to examine an improvement of plasma confinement in ion cyclotron range of frequency (ICRF) wave heated discharges. The mixed pellets were maken from the mixed gas with the different ratio of hydrogen to mixed gas (H + D). The composition of the pellet is not equal to that of the mixed gas before freezing. The in-flight mixed pellets with about 769 m/s keep their cylindrical shape, e.g. the pellets are not broken. The present results will indicate the possibility of pellet mixed deuterium and tritium, which will be necessary to in future thermonuclear fusion reactor.

20312 **(JAERI-M—87-167) Divertor characteristics in ohmically and neutral-beam-heated JT-60 discharges.** Nakamura, Hiroo; Ando, Toshiro; Yoshida, Hidetoshi; Niikura, Setsuo; Nishitani, Takeo; Nagashima, Keisuke. (Japan Atomic Energy Research Inst., Tokyo). Oct 1987. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751992/JAW.

Divertor characteristics in particle and energy control in neutral-beam (NB) heated discharges on JT-60 have been studied with injection power of up to 20 MW. The essential divertor functions are successfully obtained. In ohmically heated discharges, minimum clearances between the separatrix magnetic surface and the fixed limiter for sufficient divertor action are 1.5 cm at n-bar/ sub e/ = 1.5 x 10/sup 19/ m/sup -3/ and 2.5 to 3 cm at n-bar/sub e/ = 4 x 10/sup 19/ m/sup -3/. Global power balance studies show that, in the NB-heated divertor discharge, about 5 % to 10 % of the total absorbed power, P/sub ABS/, is radiated from the main plasma, while 50 % to 60 % is radiated in the limiter discharge. At n-bar/sub e/ = 6 x 10/sup 19/ m/sup -3/, 50 % of P/sub ABS/ flows to the divertor plate. The radiation loss in the divertor chamber is 15 % of P/sub ABS/. According to the spatial distribution of the temperature rise on the divertor plate, the half width of the heat load is less than 1 cm at n-bar/sub e/ = 1.5 to 4.4 x 10/sup 19/ m/sup -3/. Neutral pressures in the divertor chamber and around the main plasma increase in proportion to n-bar/sub e//sup 2/. Compression ratio is about 45. The effectiveness of the divertor pumping system in particle control is shown for NB-pulses of at least 1 second. Reduction of evaporation by separatrix swing is also shown.

20313 **(JAERI-M—87-169) Design, research and development of JT-60 neutral beam injector.** Kuriyama, Masaaki; Akiba, Masato; Akino, Noboru. (Japan Atomic Energy Research Inst., Tokyo). Oct 1987. 186p. (In Japanese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE88751994/JAW.

JT-60 neutral beam injector (JT-60 NBI) injects neutral hydrogen beam into JT-60 with a maximum power of 20 MW/10 sec at an energy of 75 keV (70 - 100 keV), to achieve the break even plasma condition in JT-60. The performances required to JT-60 NBI were by far exceeded the those of former neutral beam injector, and there had not been technical and engineering bases to construct the JT-60 NBI. Therefore, research and development, and design on the ion sources and other NBI components have been performed for over ten years. As a result of these R and D and design, the JT-60 NBI system was constructed and was completed in 1986. The present report describes the R and D and design processes of JT-60 NBI.

20314 **(JAERI-M—87-178) Attainment of high ion temperature plasmas in JT-60 and analysis on their transport characteristics.** Hosogane, Nobuyuki; Shimizu, Katsuhiro; Shirai, Hiroshi. (Japan Atomic Energy Research Inst., Tokyo). Nov 1987. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751998/JAW.

High ion temperatures above 10 keV were obtained in JT-60 limited plasmas by the high power neutral beam heating (H/sup 0/ -> H/sup +/), which is much higher than the maximum value, 6.5 keV, obtained in JT-60 diverted plasmas. The experiment was performed in the parameter region of I/sub p/ = 1 - 2 MA, n-bar/sub e/chemical bond/sub before/ /sub heating/ = 0.7 - 1.5 x 10/sup 19/ m/sup -3/, n-bar/sub e/chemical bond/sub end/ /sub of/ /sub heating/ = 2.5 - 4.1 x 10/sup 19/ m/sup -3/ and P/sub NBinj/ = 19 - 21.8 MW. Z/sub eff/ of the limited plasmas were high, 4 - 7, compared with those of the diverted plasmas, 1 - 2. According to the transport analysis on the difference in ion temperature between these plasmas with different Z/sub eff/, it is found that (1) because of increase in deposition power to electron, P/sub be/, with Z/sub eff/, high Z/sub eff/ is effective to raising electron temperature, and (2) since the equipartition loss is reduced by increase in electron temperature, high ion temperature is obtained in the limited plasmas with high Z/sub eff/.

20315 **(LBL—23528) Negative-ion-based neutral beams for fusion.** Cooper, W.S.; Anderson, O.A.; Chan, C.F.; Jackson, L.T.; Kunkel, W.B.; Kwan, J.W.; Leung, K.N.; Lietzke, A.F.; Purgalis, P.; Soroka, L. (Lawrence Berkeley Lab., CA (USA); Lawrence Livermore National Lab., CA (USA); Negion, Inc., Hayward, CA (USA)). Oct 1987. Contract AC03-76SF00098. 5p. (CONF-871007—74). NTIS, PC A02. Order Number DE88003852/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

To maximize the usefulness of an engineering test reactor (e.g., ITER, TIBER), it is highly desirable that it operate under steady-state conditions. The most attractive option for maintaining the circulating current needed in the center of the plasma is the injection of powerful beams of neutral deuterium atoms. The beam simultaneously heats the plasma. At the energies required, in excess of 500 keV, such beams can be made by accelerating D^- ions and then removing the electron. Sources are being developed that generate the D^- ions in the volume of a specially constructed plasma discharge, without the addition of cesium. These sources must operate with minimum gas flow, to avoid stripping the D^- beam, and with minimum electron output. We are designing at LBL highly efficient electrostatic accelerators that combine electric strong-focusing with dc acceleration and offer the possibility of varying the beam energy at constant current while minimizing breakdown. Some form of rf acceleration may also be required. To minimize irradiation of the ion sources and accelerators, the D^- beam can be transported through a maze in the neutron shielding. The D^- ions can be converted to neutrals in a gas or plasma target, but advances in laser and mirror technology may make possible very efficient photodetachment systems by the time an ETR becomes operational. 9 refs., 4 figs.

20316 **(LBL—24125) Photodetachment now.** Fink, J.H. (Lawrence Berkeley Lab., CA (USA)). Oct 1987. Contract AC03-76SF00098. 5p. (CONF-871007—81). NTIS, PC A02. Order Number DE88004566/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

To illustrate the feasibility of photodetachment, the author describes a conceptual design of photo-neutralizers for 0.5 and 3.0 MeV deuterium beams. The negative ions are stripped in optical cavities using large mirrors with higher than 99.99% reflectivity. The neutralizers are illuminated by an array of Nd:YAG slab-lasers emitting about 30 kW/m of light per unit length, while the mirrors are exposed to an irradiance of the order of 100 MW/m^2. Details of the photodetachment cells and the laser configurations have not been resolved. 9 refs., 6 figs.

20317 (ORNL—6332, pp 201-240) **Plasma technology.** Oct 1987. NTIS, PC A19/MF A01. Order Number DE88003651/JAW.

In Fusion Energy Division annual progress report period ending December 31, 1986.

The repeating pneumatic injector (RPI) continued to set records for plasmas in the Tokamak Fusion Test Reactor (TFTR) at the Princeton Plasma Physics Laboratory (PPPL), with n/sub e/(0)tau(a) = 1.4 x 10^{14} cm^{-3}/s achieved in early 1986 in ohmic plasmas. The deuterium pellet injector (DPI) was completed at the estimated cost and shipped to TFTR about one month early; it replaced the RPI, which was returned to ORNL. The DPI has met all of its design goals in testing at ORNL and PPPL. The Joint European Torus and Tore Supra pellet injector projects remained on cost and schedule throughout 1986. In the rf development area, the low-power rf antenna was installed on Doublet III-D in early 1986, and sufficient plasma coupling was demonstrated to warrant proceeding with the compact loop antenna concept for ion cyclotron resonance heating. Two further prototype applications of the compact resonant double loop antennas were initiated for the TFTR and Tore Supra tokamaks. Early in 1986, the Radio Frequency Test Facility (RFTF) was operated with its first 28-GHz, electron-cyclotron-heated, steady-state plasmas. After some minor modifications to augment the radiation shielding, the RFTF continued to reliably support the rf development program throughout 1986. In late 1986, the modified Fusion Materials Irradiation Test (FMIT) transmitter achieved 1.5 MW of output rf power for 30 s at a frequency range of 40-80 MHz; the limit on output power was determined by present rf tube technology. Significant progress was made on the development of Faraday shields and high-power capacitors for rf technology applications. A program to develop a negative-ion neutral beam source (funded by the Department of Defense) is also executed by Plasma Technology Section staff.

20318 **(ORNL/TM—10186) Emittance of the ORNL negative ion source.** Donaghy, J.J.; Dagenhart, W.K.; Kannan, K.L.; Ryan, P.M.; Stirling, W.L.; Tsai, C.C. (Oak Ridge National Lab., TN (USA)). Nov 1987. Contract AC05-84OR21400. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004763/JAW.

An electrostatic emittance scanner has been used to measure the emittance of intense H^- and D^- beams formed by ion sources developed at the Oak Ridge National Laboratory (ORNL). The ion sources have been operated reliably in both the Surface Ionization with Transverse Extraction (SITEX) and Volume Ionization with Transverse Extraction (VITEX) modes. The emittance measurements were made in a magnetic field of about 1 kg. The effective dimensions of the beamlet sample at the accelerator exit in the SITEX mode were 0.21 cm by 0.16 cm. (Here 0.16 cm is the central part of a 12.7-cm beam ribbon that is parallel to the applied source magnetic field.) The normalized rms emittances for such SITEX beamlets (~1.14 mA) were 0.01 π . cm. mrad measured transverse to the field and 0.003 π . cm . mrad measured parallel to the field for 10-keV D^- beams (36 mA/cm^2). The dimensions of H^- beams at the accelerator exit in the VITEX mode were 0.1 cm by 2.0 cm. The normalized rms emittances were about 0.013 π . cm . mrad measured transverse to the field and 0.017 π . cm . mrad measured parallel to the field for 15-keV, 12-mA (or 60-mA/cm^2) beams. The highest current density achieved is above 150 mA/cm^2. Ion temperatures obtained from the parallel emittance measure-

ments were 9.4 eV for SITEX beams and 0.6 eV for VITEX beams. In this report, the method used to analyze the measured emittance data is described, and the potential errors in measurement are discussed. 9 refs., 16 figs., 1 tab.

20319 **(UCRL—96733) Acceptable residual magnetic fields in the background of a gas neutralizer.** Fink, J.H. (Lawrence Livermore National Lab., CA (USA)). 16 Oct 1987. Contract W-7405-ENG-48. 5p. (CONF-871007—76). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88004403/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

An approximate method is described to evaluate the maximum acceptable residual magnetic field in the background of a neutral beam. 5 refs., 8 figs.

20320 **(UCRL—96735) Wiggler taper optimization for free-electron-laser amplifiers with moderate space-charge effects.** Jong, R.A.; Scharlemann, E.T.; Fawley, W.M. (Lawrence Livermore National Lab., CA (USA)). 1987. Contract W-7405-ENG-48. 16p. (CONF-8709110—15). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88003758/JAW.

From 9. international free-electron laser conference; Williamsburg, VA, USA (14 Sep 1987).

The standard synchronous tapering method used to design the wiggler magnetic field for free-electron-laser (FEL) amplifiers operating in the Compton regime will not work for amplifier systems where space-charge effects are important. The space-charge effects lower the overall gain in the amplifier system and, even more importantly, shift the peak in the gain curve to magnetic field values that are significantly less than the synchronous magnetic field value. As a result, the overall predicted gain using the synchronous tapering method is too low. Moreover, the synchronous magnetic field corresponds to the peak in the gain curve for a frequency below the fundamental frequency. Consequently, shot noise at frequencies below the fundamental frequency can grow to levels that may prevent amplification of the fundamental. We have developed a new tapering strategy that improves the predicted amplifier gain and circumvents the shot-noise growth for systems with moderate space-charge effects. For this new strategy, we hold the wiggler magnetic field constant at a value below the synchronous value but near the peak of the gain curve for the fundamental frequency, for some optimized length at the front end of the wiggler. Beyond this constant wiggler section, the field is tapered using the standrd synchronous tapering algorithm. This new tapering scheme results in significant improvement in predicted amplifier gains and limits the growth of shot noise to insignificant levels. We demonstrate the effectiveness of this new tapering algorithm using the tapered wiggler design for the proposed microwave heating experiment (MTX) at the Lawrence Livermore National Laboratory (LLNL). 4 refs., 8 figs.

20321 **Steady-state discharge test of coaxial LaB_6 cathode.** Tanaka, S.; Leung, K.N.; Purgalis, P.; Williams, M.D. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Review of Scientific Instruments;* **59**: No. 1, 120-124(Jan 1988). Contract AC03-76SF00098.

Results of steady-state discharge test of coaxial LaB_6 cathodes in a multicusp plasma generator are described. After a single-unit test of a compact, 6.4-mm-diam coaxial LaB_6 cathode, a discharge test of two cathodes with one heater power supply was carried out with success. In addition, a new tapered coaxial cathode, which was designed to prevent overheating of LaB_6 due to ohmic heating by discharge current, was investigated. During steady-state plasma source operation, a discharge current as high as 180 A was obtained with this tapered cathode.

20322 **The TFTR neutral beam control and data acquisition system.** Lagin, L.; McEnerney, J.; Arnold, N.; Chu, J.; Cropper, M.; Davis, S.; Dong, J.; Drucker, L.; Feng, H.; Fleming, G. (Plasma Physics Lab., Princeton Univ., Princeton, NJ 08544). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 772-774(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

This paper describes the computer control and data acquisition system for the Tokamak Fusion Test Reactor (TFTR) Neutral Beam injectors. The system provides hardware and software to permit remote operation of the four beamlines on TFTR, each containing up to three ion sources, and for a single-source beamline for the TFTR test stand.

20323 **The ASDEX ICRF antennae in their uncooled and cooled versions.** Noterdaeme, J.M.; Soll, M.; Wesner, F.; Braun, F.; Fritsch, R.; Hofmeister, F.; Kutsch, H.J.; Perchermeier, J.; Trcka, E.; Radtke, W. (Max-Planck-Institut fur Plasmaphysik, Euratom-Association, D-8046 Garching). pp 795-800 of Fusion technology 1986. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

In a first phase the two ICRF antennae in ASDEX were uncooled. They have operated for pulse length up to 1 s and have achieved their design level of 1.5 MW each. The paper summarizes the design principles and the characteristics of the antenna. It further reports on some interesting points concerning their manufacturing, and highlights what the authors have learned from the first phase operation. In order to be able to operate with increased heating powers and pulse lengths most components inside the ASDEX vessel and the ASDEX ICRF antennae have to be cooled. For the antennae of this second phase, the authors present the underlying design criteria, the results of the thermal and mechanical calculations and the various manufacturing steps. First tests on the thermal loading capabilities of the screen are included.

20324 **Scaling of the gas-breakdown, magnetically-shaped plasma anode to high-power ion diodes.** Greenly, J.B.; Ueda, M.; Hammer, D.A. (Cornell Univ.). pp 5 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

In this paper the authors discuss the question of whether a plasma anode can be implemented in a diode for the high voltage and current-density regime of interest for light-ion ICF. They present new measurements of critical performance parameters in the present diode, namely turn-on and ion species purity. Using these results along with the authors' understanding of the operation of the source from previous experiments, they identify limiting factors in scaling to high power, and outline further experiments to address these issues.

20325 **The effect of anode temperature on the production of lithium ions from lithium and lithium nitrate filled anodes in an Applied-B ion diode.** McKay, P.F. (Sandia National Labs., Albuquerque, NM 87185). pp 6 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—). Contract AC04-76DP00789.

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

A high purity lithium ion source is required for use in experiments on the Particle Beam Fusion Accelerator II (PBFA II) for the Inertial Confinement Fusion Program at Sandia National Laboratories. Lithium ion beams of greater than 90% purity have been generated in an extraction geometry Applied-B ion diode on a PI-110A accelerator; however, the mechanism of ion production is not yet understood. This paper explores the role of anode temperature in the production of lithium ion beams on the PI-110A in order to better understand the ion formation mechanism. In these experiments, the anode material, either lithium metal or lithium nitrate, is vertically suspended in porous stainless steel. The anode can be operated at any temperature from 20°C to temperatures above the melting point of the anode material. The goal of these experiments is to study electrohydrodynamically (EHD) driven lithium ion sources. If the mechanism is electrohydrodynamically driven, then it appears that the anode material should be molten. However, high

purity beams have been produced when the anode temperature is below the melting point of the anode material. Comparisons of ion species, quantity of ions produced, and turn-on times of the ion beam are made as a function of temperature. The diagnostics used to measure these quantities are diode voltage and current monitors, ion current monitors, charge collectors, and a Thomson parabola analyzer.

20328 **A lithium ion source for the production of anode plasma layers in Applied-B ion diodes.** Hilko, B.; Goldstein, S.A. (GT-Devices, Inc., Alexandria, VA 22312-2408). pp 6-7 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

In the development of intense light ion beams for ICF, increased attention is given to the production of preformed, high density lithium anode plasmas. General requirements of the PBFA II accelerator are high purity (>90% lithium) layer, <4 mm thick, with ion densities approaching 10/sup 17/ cm/sup -3/ and steep gradients to vacuum in the A-K gap. The authors present an approach to providing such a layer. The heart of the concept is a millimeter size, capillary discharge using lithium foil as the source material. The discharge is driven by currents — 10 kA for several microseconds to form a warm (— 1.5 eV), high pressure (— 1 kbar) plasma. Escaping plasma expands through a large area ratio, supersonic nozzle. In the process, the plasma cools to low temperature (— .2 eV) and the nozzle exhaust stream will be predominantly neutral. This stream of high velocity neutrals is directed through B applied to impinge on the anode surface, accumulating as a shock heated plasma layer.

20327 **Operation of the neutral beam heating system for the Tokamak Fusion Test Reactor.** Grisham, L.R. (Princeton Univ., Plasma Physics Lab.). pp 7 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—).

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

The majority of the plasma heating for the Tokamak Fusion Test Reactor (TFTR) is provided by a system of four neutral beam lines, each of which can accommodate three ion source that inject through neutralizers into the tokamak plasma. The initial neutral beam injection experiments began in September of 1984 with ion sources developed bu Lawrence Berkeley Laboratory (LBL) capable of 0.5 second pulses. By the completion of this phase in October of 1986, the authors had injected as much as 20 megawatts of deuterium beams into TFTR for 0.5 second, and had reached beam energies as high as 110 keV. During this period they achieved TFTR central ion temperatures of as much as 20 keV, and found evidence consistent with substantial current drive, both by direct beam effects and through the "bootstrap" process. The authors recently began injection experiments on TFTR with the long pulse ion sources. This talk discusses the beam system operation, and summarizes some of the results that have been achieved.

20328 **Computational and experimental high power microwave waveguide air breakdown at five pressures.** Mayhall, D.J.; Yee, J.H.; Alvarez, R.A.; Byrne, D.P. (Lawrence Livermore National Lab., Univ. of California, P.O. Box 808, Livermore, CA 94550). pp 10 of The 1987 IEEE international conference on plasma science (Abstracts). Piscataway, NJ; IEEE Service Center (1987). (CONF-870651—). Contract W-7405-ENG-48.

From IEEE international conference on plasma science; Crystal City, VA, USA (1 Jun 1987).

Experimental measurements of incident and transmitted power for short pulse (to 3 ns full width at half maximum), high power (to 70 MW) TE10 mode microwave air breakdown in a WR-284 waveguide are performed at five filling pressures from 0.8 to 300 Torr. Preionization with gamma ray sources is used to guarantee the reproducibility of the breakdown. Significant amounts of pulse energy (60 mJ at 300 Torr) can be transmitted down the waveguide before the breakdown becomes fully developed and cuts off the trailing part of the pulse. A two-dimensional (2D), TEmO mode, finite difference computer code is developed, which simultaneously solves the three relevant Maxwell's equations and electron fluid equations for conservation of number density, transverse momentum, and kinetic energy. The electron fluid equations include collision frequencies for avalanche ionization, as well as momentum and energy loss due to electron-neutral collisions, but neglect attachment. The code accounts for the 2D effects of the variation of the mode electric field across the waveguide and the axial dispersion of the short pulse down the guide. The preionization electron density is assumed Gaussian in the two spatial dimensions with a variable peak value and a full width at half maximum of 3 cm. The peak value varies from 0.0023 to 5.5 cm/sup -3/.

20329 **Pellet fueling development at ORNL.** Combs, S.K.; Milora, S.L.; Foster, C.A.; Schuresko, D.D.; Foust, C.R.; Simmons, D.W.; Beard, D.S. (Oak Ridge National Lab., TN, USA). pp 355-360 of Fusion technology 1986. 2 volumes. Proceedings of the fourteenth symposium, Avignon (FR), 8-12 September 1986. Oxford, England; Pergamon Press (1986). (EUR—10936-EN; CONF-860917—). Contract AC05-84OR21400.

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

Advanced plasma fueling systems for magnetic confinement devices are being developed at the Oak Ridge National Laboratory (ORNL). The general approach is that of producing and accelerating frozen hydrogenic pellets at speeds in the range of 1-2 km/s and higher. Two specific concepts are under development: (1) high-speed pneumatic acceleration and (2) mechanical (centrifugal) acceleration. Both approaches are being pursued to meet the projected pellet size and delivery rates for major near-term plasma confinement devices, such as the Tokamak Fusion Test Reactor (TFTR), Tore Supra, the Joint European Torus (JET), JT-60, and Doublet III-D (DIII-D), as well as future applications. In addition to these confinement physics related activities, ORNL is pursuing advanced technologies to achieve pellet velocities significantly, in excess of the 2-km/s range already attained with pneumatic injectors and has embarked on a development program designed to explore the feasibility of fabricating and accelerating tritium pellets.

20330 **Status of ICRF heating of tokamaks.** Wilson, J.R. (Princeton Univ., NJ). *Transactions of the American Nuclear Society;* **52**: 227(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

This work provides a description of recent developments in the ICRF heating of tokamak plasmas. The use of the fast magnetosonic wave in the ion cyclotron range of frequencies (ICRF) has become one of the most important methods of auxiliary heating of tokamak plasmas. While present-day front line experiments, such as the Joint European Torus (JET), the Tokamak Fusion Test Reactor, and JT-60, are predominantly neutral-beam heated, future machines such as the ignition studies machine have been proposed as pure ICRF machines. Present-day experimental programs are being carried out on the Princeton Large Torus (PLT), TEXTOR, the Axially Symmetric Divertor Experiment (ASDEX), JET, and JFT-2M tokamaks while experiments on JT-60 will start shortly. These experiments are exploring a variety of issues of relevance to fusion research and the status of each will be discussed.

20331 **Folded waveguide coupler for ion cyclotron heating.** Owens, T.L.; Chen, G.L. (McDonnell Douglas, St. Charles, MO). *Transactions of the American Nuclear Society;* **52**: 228-229(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

A new concept in high-power waveguide couplers for ion cyclotron range of frequencies heating is described. The structure consists of a periodic array of interleaved metallic vanes within a rectangular enclosure. It is analogous to a wide rectangular waveguide that has been folded several times to form a more compact structure. The frequency range of the waveguide is determined by the number of folds in the structure.

20332 Pneumatic pellet injectors for TFTR and JET. Combs, S.K.; Milora, S.L. (Oak Ridge National Lab., TN, USA). pp 1375-1380 of Fusion technology 1986. Proceedings of the fourteenth symposium, Avignon, France, 8-12 September 1986. In two volumes. Oxford, England; Pergamon Press (1986). (EUR—10936-EN; CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

The development of pneumatic hydrogen pellet injectors for plasma fueling applications on the Tokamak Fusion Test Reactor (TFTR) and the Joint European Torus (JET) is described. The performance parameters of these injectors represent an extension of previous experience and include pellet sizes in the range 2-6 mm in diameter and speeds approaching 2 km/s. Design features and operating characteristics of these pneumatic injectors are presented.

20333 Evaluation of polarized fuels in a commercial D-T tokamak reactor. Finn, P.A.; Brooks, J.N.; Ehst, D.A.; Gohar, Y.; Mattas, R.F.; Baker, C.C. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **52**: 200-201(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The goal of our study was to provide a limited analytical assessment of the technical and economic benefits associated with the use of polarized fuels in a commercial deuterium-tritium (D-T) tokamak fusion reactor. The effort was focused on determining key benefits accrued in the reactor systems. The balance of plant (BOP) was assumed to not be appreciably affected. The D-T system was chosen since it is likely to be the first commercial reactor system. Two types of reactors were considered: one was the Starfire reactor, which has a moderate beta, a moderate radius, and a moderate magnetic field; the other was an advanced reactor developed in Argonne National Laboratory's Tokamak Power Systems Study, which has a higher beta a smaller radius, and a lower magnetic field. Since the physical size, i.e., major radius of a reactor, significantly affects the cost of the toroidal field magnets, these two systems should provide a means of separating the size effect from effects attributable to the use of polarized fuels. A number of alternative cases were considered for the two reference cases. Our conclusions were that the use of polarized fuels in a commercial reactor can increase its performance. However, the sum of all benefits does not result in a significant improvement in reactor economics. This is especially true in situations where polarization is not 100%. The benefits of polarized fuels are quickly lost if polarization is $< 95\%$. Therefore, the primary value of polarized fuels is as an option that can be used in a given fusion reactor design if a required condition cannot be achieved in other, more standard operating modes.

20334 Super-high-field tokamaks with ohmic heating to ignition. Cohn, D.R.; Bromberg, L.; Jassby, D.L. (Massachusetts Institute of Technology, Cambridge). *Transactions of the American Nuclear Society;* **52**: 241-242(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

In addition to eliminating the need for auxiliary heating, ohmic heating to ignition may well minimize the uncertainty in extrapolation of energy confinement scaling from present tokamak devices. Assuming the continued validity of the empirical neo-Alcator scaling that characterizes present-day ohmic-heated tokamak plasmas, namely, tau/sub E/ infinity nR^2a, purely ohmic heating to ignition could be realized by operation at exceptionally high values of B^2a. (Here n is the plasma density, R is the major radius, a is the minor radius, and B is the magnetic field at the plasma). The super-high-field ohmic-heated tokamak concept discussed in this paper differs from the ignitor and Riggatron approaches in the use of substantially higher values of B, B^2a, and R, in order to take advantage of the empirical confinement scaling.

20335 Tritium technology studies at the tritium systems test assembly. Anderson, J.L.; Bartlit, J.R. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **52**: 276(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The Tritium Systems Test Assembly (TSTA) at Los Alamos National Lab. is charged with developing the tritium technology required to fuel a fusion reactor. This technology includes vacuum systems for exhausting unburned deuterium-tritium (D-T) from the reactor; purification systems for removing chemical impurities from this exhaust gas; isotopic separation systems for separating D_2, T_2, and D-T; circulation and transfer pumps; and the evaluation, but not development, of tritium pellet injections. A second major task at TSTA is the development and evaluation of safety and environmental systems associated with the tritium handling facilities at a fusion reactor. This includes development of new tritium monitors; room air detritiation systems; gaseous effluent treatment systems; secondary and tertiary containment techniques; and techniques for performing routine and emergency maintenance on tritium-contaminated systems.

20336 Residual tritiated water in molecular sieves. Nasise, J.E.; Carlson, R.V.; Jalbert, R.A. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **52**: 276-277(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

This paper discusses results of experiments that measured the residual tritiated water remaining on the sieve after regeneration and experiments to determine if the tritium inventory can be reduced after regeneration. Three types of experiments were performed. First, molecular sieve was placed in a standard calorimeter, which measures the heat resulting from the decay of the residual tritium in the sieve. These measurements indicated an average residual tritium concentration of 0.3 Ci/g of molecular sieve. However, there were substantial variations in the calorimeter readings from run to run. Second, small samples of sieve were soaked in water to leach out the tritiated water. Samples of the water were then measured in a liquid scintillation counter to determine the quantity of tritium in the liquid. These experiments indicated a residual tritium concentration of 0.08 Ci/g of molecular sieve. Third, an additional sample of the molecular sieve was heated and dissolved in Na_2CO_3 in a glove box. The tritium that evolved was then measured by noting the increase in the tritium concentration in the glove box. This experiment indicated a minimum tritium concentration of 0.03 Ci/g of molecular sieve.

20337 Tritium system for a tokamak reactor with a self-pumped limiter. Hassanein, A.M.; Sze, D.K. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **52**: 279-280(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Benefits of the self-pumping system are the elimination of vacuum ducts, pumps, and penetration shielding (except for a very small startup system), and the reduction of tritium recycle and refueling. In addition, a self-pumped system may perform better and last longer than alternative systems such as a pumped limiter. The reference case here is a self-cooled lithium/vanadium blanket with a first wall/limiter. This concept combines the functions of first wall and limiter into a single first-wall structure. The wall is shaped in accordance with the outermost plasma flux surface. Trapping material is added to the plasma scrape-off or edge region where it is transported to the wall. The entire wall area is used for helium trapping. The tritium inventory, tritium permeation rate, and plasma protium concentration for the vanadium wall as a function of the number of years of operation are calculated. The tritium inventory is acceptable, the protium concentration in the plasma is acceptably small, and the tritium permeation rate is moderate. At the start of operation, it is equal to about five times the tritium burnup rate. This tritium will enter the coolant and the cost of the blanket tritium recovery system will be higher.

20338 Process to recover tritium from high-pressure helium. Finn, P.A.; Sze, D.K. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **52**: 280(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

A coolant that has gained increased prominence in fusion reactor designs is high-pressure ($\geqq$ 50 atm) helium. One of the major

problems to be resolved with this coolant is effective tritium removal and recovery so that environmental losses are minimized but the efficiency of the plant is not compromised. Since the worse case situation is one in which the high-pressure helium coolant is used not only as a coolant but also as the main tritium recovery route, we directed our attention to designing a tritium recovery system that could handle this worst case, as well as simpler cases. The design that evolved was a system in which a liquid getter (sodium is our example case) is used to strip all tritium, deuterium, and oxygen species from the high-pressure helium. The hydrogen species are removed from the sodium either by using a cold trap or by contacting the sodium with a molten salt. The tritium can be recovered from the molten salt by electrolysis. Impurities, including oxygen, are removed from the sodium through the use of a cold trap on a small fraction (≦ 10%) of the total sodium flow.

20339 **(DPST—87-823) Savannah River Laboratory contribution to the Chalk River experimental HT release of June 1987.** Murphy, C.E. Jr. (Savannah River Lab., Aiken, SC (USA)). 17 Nov 1987. Contract AC09-76SR00001. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003763/JAW.

Seventeen years ago, a series of experiments were conducted at Bruyeres-Le-Chatel by French scientists interested in atmospheric diffusion. The scientists used tritium as a tracer in these tests. The results showed nearly complete oxidation of the gas by the time the released material had been carried 10 kilometers from the source. It became clear that if the results were general, the doses projected for fusion reactors would be greatly increased over what had been expected from earlier experience with HT gas. For this reason, the Next European Torus (NET) fusion program funded a series of experiments to look further at tritium oxidation in the environment. SRL participation in the tests provided an opportunity to make field comparisons of the SRL design tritium gas samplers and also provided vegetation that had been exposed under controlled conditions which could be used to study the incorporation of tritium into vegetation organics, the subject of ongoing SRL research. 25 refs., 4 figs., 2 tabs.

20340 **(EGG—2528) Fusion Safety Program annual report: Fiscal year 1987.** Holland, D.F.; Herring, J.S.; Longhurst, G.R.; Lyon, R.E.; Merrill, B.J.; Piet, S.J. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1988. Contract AC07-76ID01570. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88006137/JAW.

This report summarizes the Fusion Safety Program major activities in fiscal year 1987. The Idaho National Engineering Laboratory (INEL) is the designated lead laboraotry and EG and G Idaho, Inc., is the prime contractor for this program, which was initiated in 1979. Activities are conducted at the INEL and in participating laboratories including the Hanford Engineering Development Laboratory (HEDL), the Massachusetts Institute of Technology (MIT), and the University of Wisconsin. The technical areas covered in the report include tritium safety, activation product release, reactions involving lithium breeding materials, safety of fusion magnet systems, plasma disruptions, risk assessment methodology, computer codes development for reactor transients, and fusion waste management. Also included in the report is a summary of the safety and environmental analysis and conventional facilities design performed by INEL for the Compact Ignition Tokamak design project, the safety analysis and documentation performed for the Tokamak Ignition/Burn Experimental Reactor design, and the technical support provided to the Environmental Safety and Economics Committee (ESECOM). 42 refs., 17 figs., 4 tabs.

20341 **(EGG-FSP—7872) Potential off-normal events and associated radiological source terms for the compact ignition tokamak: Fusion Safety Program.** Holland, D.F.; Lyon, R.E. (EG and G Idaho, Inc., Idaho Falls (USA)). Oct 1987. Contract AC07-76ID01570. 57p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004112/JAW.

The Compact Ignition Tokamak (CIT), the latest step in the United States program to develop the commercial application of fusion power, is designed as the first fusion device to achieve ignition conditions. It is to be constructed near Princeton, New Jersey on the site of the existing Tokamak Fusion Test Reactor (TFTR). To address the environmental impact and public safety concerns, a preliminary analysis was performed of potential off-normal radiological releases. Operational occurrences, natural phenomena, accidents with external origins, and accidents external to the PPPL site were considered as potential sources for off-normal events. Based on an initial screening, events were selected for preliminary analysis. Included in these events were tritium releases from the tritium delivery and recovery system, tritium releases from the torus, releases of activated nitrogen from the test cell or cryostat, seismic events, and shipping accidents. In each case, the design considerations related to the event were reviewed and the release scenarios discussed. Because of the complexity of some of the proposed safety systems, in some cases event trees were used to describe the accident scenarios. For each scenario, the probability was estimated as well as the release magnitude, isotope, chemical form, and release mode. 10 refs., 17 figs., 5 tabs.

20342 **(EGG-M—14087) Safety and environmental analyses and conclusions for TIBER-II.** Piet, S.J.; Stasko, R.R. (EG and G Idaho, Inc., Idaho Falls (USA); Canadian Fusion Fuels Technology Project, Toronto, Ontario). 1987. Contract AC07-76ID01570. 5p. (CONF-871007—87). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005540/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The safety and environmental characteristics of the TIBER-II (Tokamak Ignition/Burn Experimental Reactor) design have been studied, focusing on innovative design features. Analyses included accident concerns, maintenance exposure, effluent control, and waste management. Unresolved problems include removal of decay heat from the high activation tungsten inboard shield, provision for rapid, passive, and benign plasma shutoff, compatibility between liquid-metal test modules and water-cooled blanket/shield, and elimination of high level wastes. 3 refs., 1 fig., 3 tabs.

20343 **(GA-A—18947) Fusion reactor cost reductions by employing non-nuclear grade components.** Bourque, R.F.; Maya, I.; Schultz, K.R.; Sonn, D.L.; Wise, R.K. (GA Technologies, Inc., San Diego, CA (USA)). Nov 1987. Contract W-7405-ENG-48. 9p. (UCRL—15911; CONF-871007—55). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004646/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

The Cascade inertial confinement fusion reactor fits the requirements of low radioactive inventories and inherent safety and is therefore a candidate for non-nuclear construction throughout. This reactor consists of a rotating blanket of ceramic granules that absorb the energy from D-T target explosions occurring along the rotational axis. Laser energy is beamed in axially from both ends. Two cost estimates were made for an 815 MWe Cascade power plant. One was based on an "all conventional" plant, which is constructed and costed using well-established, conventional fossil power plant methods. The second was a "nuclear plus conventional" design, constructed and costed using a combination of fossil and fission reactor plant methods and standards that would be typical of advanced fission reactors. The total capital requirements for the "all conventional" construction plant were estimated in 1985 dollars at $1490 M, including indirect costs. Similarly, the "nuclear plus conventional" construction plant was estimated at $1940 M. The savings of $450 M (23%) represents strictly the difference between Cascade ICF power plants designed and constructed to nuclear safety-related requirements versus all non-nuclear. This example clearly shows that, if fusion plants can take advantage of low activation materials and inherent safety features to eliminate the need for nuclear-related expenses, then such plants may have economic advantages over nuclear-grade systems. 13 refs., 1 fig., 5 tabs.

20344 **Environmental effects of fusion power plants. Part II: Tritium effluents.** Watson, J.S.; Easterly, C.E.; Cannon, J.B.; Talbot, J.B. (Oak Ridge National Lab., Fusion Environmental Program, P.O. Box X, Oak Ridge, TN 37831). *Fujitsu Scientific and Technical Journal;* **12**: No. 3, 354-363(Nov 1987). Contract AC05-84OR21400.

Tritium releases from fusion reactors were estimated for normal (nonaccident) operating conditions. The STARFIRE reactor design was used as a reference case, but the effects of alternate design choices and conditions were also addressed. Potential environmental losses were examined for each of the major tritium handling systems. Estimates of — 20 Ci/day were made for the 1000-MW(electric) reactor, with approximately equal portions coming from the gas handling systems (plasma, vacuum, and fuel systems) and from the coolant system.

20345 **Environmental effects of fusion power plants. Part I: Effluents other than tritium.** Cannon, J.B.; Easterly, C.E.; Davis, W. Jr.; Watson, J.S. (Oak Ridge National Lab., Fusion Environmental Program, Oak Ridge, TN 37831). *Fujitsu Scientific and Technical Journal;* **12**: No. 3, 341-353(Nov 1987). Contract AC05-84OR21400.

Radioactive and nonradioactived effluents are released routinely during normal operation of near-term commercial fusion power reactors. Nonradioactive effluents are essentially the same as those released at conventional steam-electric power plants. Radioactive effluents consist of activated corrosion products and tritium. Most radioactive releases originate from liquid-waste processing systems and from ventilation systems of various building where radioactivity may become airborne. These effluents have some potential for environmental impact; however, the significance of the impact depends in part on the concentration and release rate of the effluent.

20346 **Inherent/passive safety for fusion.** Piet, S.J. (EG & G Idaho Inc., Idaho Falls). *Transactions of the American Nuclear Society;* **52**: 247-248(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Fusion's success depends on having attractive safety and economic features. One of fusion's inherent advantages is the potential for being safer than other technologies. We should work toward making the potential become a demonstrable, cost-saving reality. Fusion safety should not be hard to prove nor require many expensive, complicated active engineered safety systems.

20347 **TFTR off-site dose levels from fusion radiation and effluent releases.** Kolibal, J.; Ku, L.P.; Liew, S.L. (Princeton Plasma Physics Lab., NJ). *Transactions of the American Nuclear Society;* **52**: 254-256(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

A comprehensive assessment of the off-site radiological impact of the operation of the Tokamak Fusion Test Reactor (TFTR) is made. This includes a review of the dose levels from skyshine for the case with no igloo shield around the tokamak, and from the release of radionuclides due to air activation products. The dispersion analysis is based on local on-site meteorological data that have recently become available. The results show that the original design guidelines of < 10 mrem off-site dose from all sources can be met with a total neutron production of $< 1.5 \times 10^{19}$ deuterium-tritium (D-T) neutrons, or 4.0×10^{19} deuterium-deuterium neutrons.

20348 **Activation analysis of the Compact Ignition Tokamak.** Selcow, E.C. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **52**: 308-309(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The US fusion program is planning the construction and operation of a near-term tokamak device that achieves ignition. Design concepts for this machine are focused on compact systems to achieve minimum costs. The high neutron wall loadings associated with these compact deuterium-tritium (D-T)-burning devices indicate that radiation-related issues may be significant considerations in the overall system design. The main objective of this study is to quantify the radiation-related concerns associated with the design of the compact ignition tokamak.

20349 **Innovative neutron energy conversion for D-T fusion.** Perkins, L.J. (Lawrence Livermore National Lab., CA). *Transactions of the American Nuclear Society;* **52**: 195-196(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The author have considered eight alternative methods for producing electricity from D-T neutrons. Several are not Carnot-limited (i.e., do not involve an intermediate heat stage) and four are fusion-specific (i.e., exploit the unique properties of D-T fusion). Of these eight schemes, two methods were selected for further study at LLNL, and serve to illustrate that boiling water in a conventional steam cycle may not necessarily be the only complement to a D-T fusion power core. They are briefly described here. These methods are radiation-catalyzed MHD conversion and excimer-channeled UV conversion.

20350 **In situ MHD energy conversion.** Logan, B.G. (Lawrence Livermore National Lab., CA). *Transactions of the American Nuclear Society;* **52**: 196-198(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Magnetohydrodynamic (MHD) energy conversion of blanket neutron heat in a magnetic fusion reactor is proposed using MHD generators within the existing magnet coils, called in situ MHD energy conversion. X-ray bremsstrahlung and microwave synchrotron radiation from the plasma is used to enhance the in situ MHD conversion efficiency by superheating the MHD generator vapor to temperatures higher than local wall temperatures, and by enhancing the vapor conductivity through nonequilibrium ionization (T/sub e/ >> T/sub gas/). Rankine cycles using cesium-seeded mercury, cadmium, zinc, or magnesium metal vapors keep the power-conversion loop within the reactor, to minimize total plant capital costs. Development of in situ MHD for tokamak reactors should be quite consistent with the development of fusion itself. The basic ingredients are similar: plasmas, large magnets, radiation, and high-performance materials. There already exists a large data base on MHD generators that have achieved up to 10 to 15% efficiency, at temperatures (3000 K) twice as high as contemplated here, for many hours at a time. To help achieve the modest (but important) efficiency improvement factors of 2 to 3, this concept proposes a new ingredient-synchrotron radiation-which is unique to magnetic fusion. Experiments with microwave heating in MHD channels could be done in advance with gryotrons and magnets available in many fusion laboratories. High tokamak plasma temperatures and moderate betas are required to produce synchrotron radiation for in situ MHD. The MHD generators could be incorporated in modular tokamak architectures and silo vaults. Refractory materials with $>$ 100 dpa life at 1000 K and $>$ 1 dpa life at 1500 to 1800 K are needed. Microwave heating in MHD channel experiments could be tested with gyrotrons and magnets available in fusion laboratories.

20351 **(AD-A—185945/3/XAB) Rayleigh-Taylor instability in ablatively accelerated targets with 1, 1/2 and 1/4 micrometers laser light. Interim report, 1 October 1986-22 September 1987.** Emery, M.H.; Dahlburg, J.P.; Gardner, J.H. (Naval Research Lab., Washington, DC (USA)). 22 Sep 1987. 29p. NTIS, PC A03/MF A01.

Results of a series of detailed numerical simulations are presented for the Rayleigh-Taylor instability in laser ablatively accelerated targets for a fairly wide range of initial conditions. It is shown that the Rayleigh-Taylor growth rate in an ablative environment is a strong function of the laser wavelength. For perturbation wavelengths about 3 times the inflight-target thickness, the ratios of the numerical growth rates to the classical growth rates are of the order of 1/1.5, 1/2.5 and 1/3.5 for 1, 1/2- and 1/4-micrometer laser light, respectively. The numerical results are in good agreement with theoretical based on the ablative convection of vorticity away from the unstable ablation front. These results provide strong evidence for the viability of high-aspect-ratio shells in direct-drive laser fusion.

20352 **(CONF-870836—2) Reactor potential of the Magnetically Insulated Inertial Confinement Fusion (MICF) system.** Kammash, T.; Galbraith, D.L. (Michigan Univ., Ann Arbor (USA)). 1987. Contract FG02-87ER13723. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005554/JAW.

From Energy independence conference; Rio de Janeiro, Brazil (17 Aug 1987).

In this paper a quasi one dimensional, time dependent set of particle and energy balance equations for the thermal species, namely, electrons, ions and thermal alphas which also allows for an appropriate set of fast alpha groups is utilized to assess the reactor prospects of a DT-burning Magnetically Insulated Inertial Confinement Fusion (MICF) system. A reference reactor consisting of an initial plasma with density of 10^{21} cm^{-3}, temperature of keV, a radius of 0.25 cm is shown to ignite and yield an energy multiplication factor "Q" of about 60 when the plasma is allowed to burn for 2 microseconds. When the burntime is extended to 9 microseconds for the same initial conditions our calculations show that Q almost doubles just before the final radius becomes equal to the inner radius of the shell. These preliminary results seem to indicate that MICF does indeed have the potential for a reactor although some relevant physics issues need to be addressed first. 42 refs., 6 figs.

20353 **(DOE/DP/40200—63-Vol.32) LLE review: Quarterly report, July-September 1987.** Donaldson, W. (ed.). (Rochester Univ., NY (USA). Lab. for Laser Energetics). 1987. Contract FC08-85DP40200. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88003986/JAW.

This volume of the LLE Review, covering the period July-September 1987, contains an article on the measurement of rho R in high-compression laser-fusion experiments using secondary reactions. The section on advanced technology has reports on the development of high-repetition-rate active-mirror amplifiers; electro-optic time-domain reflectometry; a new electro-optic finger probe; picosecond high-energy electron diffraction; and a method of using radial transmission lines to obtain very high electric fields. Finally, the activities of the National Laser Users Facility and the glass development and OMEGA laser facilities are summarized. The highlights of this issue are: A method for measuring the rho R in high-density laser-fusion experiments is described. A 3.8-cm, clear-aperture Cr:Nd:GSGG active mirror has been designed and constructed. Two articles describe electro-optic sampling. The first deals with a method that employs counterpropagating electric pulses to facilitate the acquisition of distortion-free electro-optic signals for time-domain reflectometry. The second describes a new finger probe that uses total internal reflection of the optical probe. A new probe uses picosecond burst of electrons to study the structure of surfaces. High-energy electrons reflect off the surface to give a time-resolved diffraction pattern. An ultrafast high-voltage pulse injected into a radial transmission line exhibited a voltage gain of 2. This was the first experiment to demonstrate the feasibility of this concept for the construction of high-gradient, compact electron accelerators.

20354 **(ENEA-RT-FUS—87-9) The physical basis for numerical fluid simulations in laser fusion.** Atzeni, S. (ENEA, Rome (Italy)). Jul 1987. 104 p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751907/JAW.

The main emphasis is on processes relevant to the description of the direct-drive approach. The relevant atomic physics modeling is discussed in connection with the peculiar density-temperature range of laser fusion experiments. Models for the transport of radiation, suprathermal charged particles and neutrons, as well as, for laser-matter interaction, are reviewed. A survey of selected applications of fluid codes for "model problems" of particular physical aspects of laser fusion, for the simulation of present experiments, and for the design of reactor-size targets, is then presented. It is concluded that the basic physical modeling employed by state-of-the-art fluid codes seems to be adequate for the simulation of the class of experiments of interest, as well as, for the overall target design. Indeed, results of experiments that are not dominated by fluid instabilities are simulated quite satisfactorily. Also, 2-D simulations have permitted the first quantitative studies on several fluid instabilities and studies on the effects of large-scale length non-uniform irradiation.

20355 **(GSI—87-15) High energy density in matter produced by heavy ion beams. Annual report 1986.** (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). Aug 1987. 59p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88752233/JAW.

This annual report summarizes the results of research carried out in 1986 within the framework of the program 'High Energy Density in Matter Produced by Heavy Ion Beams' which is funded by the Federal Ministry for Research and Technology. Its initial motivation and its ultimate goal is the question whether inertial confinement can be achieved by intense beams of heavy ions. (orig./HSI).

20356 **(IAE—4232/1) Finite emittance electron beam selfmodulation in generated wave fields and spiral ondulator magnetic field.** Pitatelev, M.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1985. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703195/JAW.

The process of electron selfmodulation in free electron laser is considered taking into account finiteness of electron beam emittance. Characteristic equation describing the process of the beam selfmodulation and radiation generation is obtained. Different threshold regimes of the generation are analyzed. 9 references, 1 figure, 1 table.

20357 (INIS-BR—748, pp 145) **Methanol lasers : new lines and spectroscopy.** Scalabrin, A.; Pereira, D. (Universidade Estadual de Campinas, Brazil). 1986. (In Portuguese). NTIS (US Sales Only), PC A09/MF A01. Order Number DE87780170/JAW. (CONF-8604347—).

From 9. national meeting on condensed matter physics; Pocos de Caldas, MG, Brazil (23 Apr 1986).

20358 **(LA—11141-MS-Vol.1) HIFSA: Heavy-Ion Fusion Systems Assessment Project: Volume 1, Executive summary.** Dudziak, D.J.; Herrmannsfeldt, W.B.; Saylor, W.W. (Los Alamos National Lab., NM (USA)). Dec 1987. Contract W-7405-ENG-36. 22p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005114/JAW.

The Heavy-Ion Fusion Systems Assessment (HIFSA) was conducted with the specific objective of evaluating the prospects of using induction-linac heavy-ion accelerators to generate economical electrical power from Inertial Confinement Fusion (ICF). Cost/performance models of the major fusion power plant systems were used to identify promising areas in parameter space. Resulting cost-of-electricity projections for a plant size of 1 GWe are comparable to those from other fusion system studies, some of which were for much larger power plants. These favorable projections maintain over an unusually large domain of parameter space but depend especially on making large cost savings for the accelerator by using higher charge-to-mass ratio ions than assumed previously. The feasibility of realizing such savings has been shown by (1) experiments demonstrating transport stability better than anticipated for space-charge-dominated beams, and (2) theoretical predictions that the final transport and pulse compression in reactor-chamber environments will be sufficiently resistant to streaming instabilities to allow successful propagation of neutralized beams to the target. Results of the HIFSA study already have had a significant impact on the heavy-ion induction accelerator R and D program, especially in selection of the charge-state objectives. Also, the study should enhance the credibility of induction linacs as ICF drivers.

20359 (LA—11141-MS-Vol.2, pp 1.1.1-1.1.3) **Unclassified summary of the theoretical heavy-ion target effort at Los Alamos National Laboratory.** Magelssen, G.R. Dec 1987. NTIS, PC A18/MF A01. Order Number DE88005082/JAW.

In HIFSA: Heavy-Ion Fusion Systems Assessment Project: Volume 2, Technical analyses.

The impact of illumination geometry, ion particle energy, beam power, beam radius, and 100% polarized DT fuel on high-gain direct-and-indirect-drive single-shell heavy ion driven targets was the focus of their unclassified effort during the heavy ion sys-

tems study. The effort resulted in scaling relations for three single-shell target concepts. They give a brief summary of their work.

20360 (LA—11141-MS-Vol.2, pp 1.1A.1-1.1A.17) **Gain scaling relations-heavy-ion targets.** Magelssen, G.R. Dec 1987. NTIS, PC A18/MF A01. Order Number DE88005082/JAW.

In HIFSA: Heavy-Ion Fusion Systems Assessment Project: Volume 2, Technical analyses.

Scaling relationships among the relevant reactor, drive and target parameters and gain for three heavy ion target concepts are presented. These relations include scaling laws for the required peak power and ion energy, the fuel fractional burnup, and the fraction of energy released in charged particles and x-rays as a function of the target radius, the hydrodynamic coupling efficiency, and the incident ion energy. The impact of polarized DT fuel on the scaling relations is also show, and the direct drive concept is examined to illustrate some of the ideas used in developing a hydrodynamic efficiency model.

20361 (LA—11141-MS-Vol.2, pp 1.2.1-1.2.40) **Heavy-ion fusion target cost model.** Pendergrass, J.H.; Harris, D.B.; Dudziak, D.J. Dec 1987. NTIS, PC A18/MF A01. Order Number DE88005082/JAW.

In HIFSA: Heavy-Ion Fusion Systems Assessment Project: Volume 2, Technical analyses.

A new model for the cost of production of heavy-ion fusion D-T targets in dedicated on-site target factories is presented for power plants. The model treats single-shell and double-shell direct-drive and generic indirect-drive targets. Target factory capital costs, non-tritium target-materials costs, and target factory operations and maintenance costs are estimated for target substructures such as fuel capsules, radiation cases, and driver energy absorption regions. These individual estimates are combined to obtain the total target cost. Realistic scaling of target costs with variations of such important performance parameters as target factory production capacity and driver pulse energy is emphasized. The model can be modified and used for other inertial fusion drivers and fuels. Typical target cost estimates fall into the range of $0.25 to $0.45 (US) per target. The estimated target cost contribution to the total cost of production of electric power is typically about 4 to 7 mills/kWh.

20362 (LA—11141-MS-Vol.2, pp 1.3.1-1.3.3) **Summary of ion target physics at Lawrence Livermore National Laboratory.** Bangerter, R.O. (Lawrence Livermore National Lab., CA). Dec 1987. NTIS, PC A18/MF A01. Order Number DE88005082/JAW.

In HIFSA: Heavy-Ion Fusion Systems Assessment Project: Volume 2, Technical analyses.

The design of a heavy-ion fusion power plant inevitably involves compromises among the various subsystems of the plant such as the targets, the accelerator, and the fusion chamber. For example, target energy gain increases with increasing input energy and decreasing focal spot size. However the cost and technical difficulty of building an accelerator also increase with increasing energy and decreasing spot size. Therefore in order to optimize the entire power plant system, it is necessary to understand how target energy gain depends on beam energy and focal spot size mentioned above and also other beam characteristics such as ion range, temporal pulse shape, and illumination geometry. Target design efforts and target simulation are briefly outlined.

20363 (LA—11141-MS-Vol.2, pp 1.3A.1-1.3A.15) **Recent Livermore research on ion beam fusion targets that (A) utilize direct drive efficiency while optimizing symmetry (B) utilize polarized DT-fuel.** Mark, J.W.K. (Lawrence Livermore National Lab., CA). Dec 1987. NTIS, PC A18/MF A01. Order Number DE88005082/JAW.

In HIFSA: Heavy-Ion Fusion Systems Assessment Project: Volume 2, Technical analyses.

The authors have investigated several examples of ion beam targets which utilize the energy efficiency of direct drive while at the same time optimizing on the symmetry requirements. Heavy ion beams of charge state $Z \geqq 3$ at 5-10 GeV have $<$ 15-20 m bending radii with 3.5 Tesla fields. Beams like these could be used with targets involving direct drive. Control of asymmetries in direct-drive ion beam targets depends on control of the effects of residual target asymmetries after an appropriate illumination scheme has been adopted. In this article, they outline results on their investigations into ion beam target concepts in which the effects of residual asymmetries are ameliorated. Thirty-two beams are placed according to their axially symmetric Gaussian-quadrature illumination scheme. The targets survive the effects of residual asymmetries in their recent 2D hydrodynamic simulations. They have also briefly discussed the additional positive effects of polarized DT-fuel on ion beam targets.

20364 (LA—11141-MS-Vol.2, pp 2.1.1-2.1.38) **Analysis of an induction linac driver system for inertial fusion.** Hovingh, J.; Brady, V.O.; Faltens, A.; Keefe, D.; Lee, E.P. (Lawrence Livermore National Lab., CA). Dec 1987. NTIS, PC A18/MF A01. Order Number DE88005082/JAW.

In HIFSA: Heavy-Ion Fusion Systems Assessment Project: Volume 2, Technical analyses.

A linear induction accelerator that produces a beam of energetic (5 to 20 GeV) heavy (130 to 210 amu) ions is a prime candidate as a driver for inertial fusion. Continuing developments in sources for ions with charge state greater than unity allow a potentially large reduction in the driver cost and an increase in the driver efficiency. The use of high undepressed tunes ($\sigma \approx 85°$) and low depressed tunes ($\sigma \approx 8.5°$) also contributes to a potentially large reduction in the driver cost. The efficiency and cost of the induction linac system is discussed as a function of output energy and pulse repetition frequency for several ion masses and charge states. The cost optimization code LIACEP, including accelerating module alternatives, transport modules, and scaling laws is presented. Items with large cost-leverage are identified as a guide to future research activities and development of technology that can yield substantial reductions in the accelerator system cost and improvement in the accelerator system efficiency. Finally, a cost-effective strategy using heavy-ion induction linacs in a development scenario for inertial fusion is presented.

20365 (LA—11141-MS-Vol.2, pp 3.1.1-3.1.25) **Heavy-ion beam transport through liquid-lithium first wall ICF reactor cavities.** Stroud, P.D. Dec 1987. NTIS, PC A18/MF A01. Order Number DE88005082/JAW.

In HIFSA: Heavy-Ion Fusion Systems Assessment Project: Volume 2, Technical analyses.

This analysis addresses the critical issue of the final transport of a heavy-ion beam in an inertial confinement fusion reactor. It has been a commonly held view that streaming modes would disrupt the transport of a heavy-ion beam across the reactor cavity for background chamber pressure in the range of 10^{-4} to 10^{-1} torr. For a liquid-lithium first-wall operating at a reasonable temperature, however, the background pressure will be in just this range. As a result of this analysis, it is demonstrated that the beam expansion caused by these streaming modes will be negligible over a wide range of reactor parameters. Liquid-lithium first-walls may be used and operated at temperatures high enough to assure good thermal conversion efficiency. The kinetic-energy-per-beam ion may be lowered, resulting in significant cost reduction in the accelerator system. Smaller beam ports may be used to reduce the problem of differential pumping between the cavity and the beam lines. More energy can be carried in each beam if fewer beams are desired. Parameter interrelationships have been obtained that constrain the boundary between beam delivery and beam disruption. These should prove valuable in performing systems analyses and trade-off studies, as well as in identifying optimum design points. This analysis is conservative and the window in HIF reactor design parameter space should be even larger than indicated here.

20366 (LA—11141-MS-Vol.2, pp 3.2.1-3.2.14) **HIF transport issues for $P > 10^{-3}$ torr and $Z > 1$.** Olson, C.L. (Sandia National Labs., Albuquerque, NM). Dec 1987. NTIS, PC A18/MF A01. Order Number DE88005082/JAW.

In HIFSA: Heavy-Ion Fusion Systems Assessment Project: Volume 2, Technical analyses.

Final transport schemes for HIF are examined, with emphasis on transport for $p > 10^{-3}$ torr and $Z > 1$ since this should simplify the reactor design and reduce the length of the accelerator.

Specifically the question of charge neutralization is addressed. They find (1) the fractional neutralization f/sub i/ needed scales as f/sub i/ = (1 - Z^{-2}), which means f/sub i/ > 0.89 is needed for Z > 3; (2) axially-trapped electrons limit the net beam potential to e phi/sub min/ = α (1/2 m/sub e/v/sub i/^{2}), with $1 \leq \alpha \leq 4$; (3) radially-expelled plasma ions increase f/sub i/, especially near the pellet; (4) radially-oscillating plasma electrons have an adiabatic limit of f/sub i/ = 0.5; and (5) as f/sub i/ approaches unity, plasma particle trajectories may involve drift motions along, and radially away from, the ion beam. Also, criteria are given for the maximum Z/A allowed for transporting very large currents. For the HIF parameters used, it appears that neutralization will probably be adequate for $Z \leq 3$.

20367 (LA—11141-MS-Vol.2, pp 3.3.1-3.3.6) **Charge and current neutralization physics of a heavy-ion beam during final transport.** Magelssen, G.R.; Forslund, D.W. Dec 1987. NTIS, PC A18/MF A01. Order Number DE88005082/JAW.

In HIFSA: Heavy-Ion Fusion Systems Assessment Project: Volume 2, Technical analyses.

Heavy-ion fusion requires high power to be focused onto a small pellet. If the reactor chamber pressure is below 10^{-4}-10^{-5} torr, beam compression will be limited by space charge unless neutralized by co-moving electrons. If higher chamber pressures are used, the heavy-ion beam will create a significant number of background electrons during its propagation and will undergo stripping. The background electrons could provide the neutralization required for high beam intensities. In this paper they will focus on the physics associated with propagation through a fully ionized hydrogen plasma, so background electron generation is not included. One-dimensional electrostatic and two-dimensional fully electromagnetic particle-in-cell simulations are presented. If a background plasma is present, they find that coinjected electrons whose purpose is to charge and current neutralize the ion beam become two-stream unstable and no longer provide the thermally cool neutralization required. Further, they find that the ion induced-background electron temperature is very sensitive to the ion-beam to background electron-charge-density ratio.

20368 (LA—11141-MS-Vol.2, pp 3.4.1-3.4.2) **Target beam-plasma interaction and ion range.** Magelssen, G.R. Dec 1987. NTIS, PC A18/MF A01. Order Number DE88005082/JAW.

In HIFSA: Heavy-Ion Fusion Systems Assessment Project: Volume 2, Technical analyses.

Unlike the effort in West Germany, in the past little theoretical effort or experimental thought has been given to the beam-target coupling problem. This situation has continued during the systems study. A few years ago an attempt was made to understand some of the physics occurring in the target plasma corona. The physics was very complex; so, without an experimental program for guidance, there was little incentive for continuing the work. A strong theoretical and experimental program is needed. They give a brief summary of some of the physics they believe should be pursued.

20369 (LA—11141-MS-Vol.2, pp 3.5.1-3.5.26) **Cavity gas clearing and pumping.** Peterson, R.R. (Univ. of Wisconsin, Madison). Dec 1987. NTIS, PC A18/MF A01. Order Number DE88005082/JAW.

In HIFSA: Heavy-Ion Fusion Systems Assessment Project: Volume 2, Technical analyses.

The limits on the cavity gas density required for beam propagation and condensation times for material vaporized by target explosions can determine the maximum repetition rate of heavy-ion-beam (HIB) driven fusion reactors. If the ions are ballistically focused onto the target, the cavity gas must have a density below roughly 10^{-4} torr (3×10^{12} cm^{-3}) at the time of propagation; other propagation schemes may allow densities as high as 1 torr or more. In some reactor designs, several kilograms of material may be vaporized off of the target chamber walls by the target-generated x rays, raising the average density of the cavity to 100 torr or more. A one-dimensional combined radiation-hydrodynamics and vaporization-and-condensation computer code has been used to simulate the vaporization and condensation of material in the target chambers of HIB fusion reactors. Additionally, the gas pumping requirements have been studied for a representative HIB reactor concept. Conclusions are drawn as to the allowable repetition rates in various target chamber designs, with various ion beam propagation limits.

20370 (LA—11141-MS-Vol.2, pp 4.1.1-4.1.17) **Heavy-ion fusion system assessment: final focus and transport model.** Lee, E.P.; Faltens, A.; Keefe, D.; Hovingh, J. (Lawrence Berkeley Lab., CA). Dec 1987. NTIS, PC A18/MF A01. Order Number DE88005082/JAW.

In HIFSA: Heavy-Ion Fusion Systems Assessment Project: Volume 2, Technical analyses.

The required small spot size on the pellet is met by low specified emittance, small momentum spread, and a set of other focal and reactor constraints that are only partially understood at present. The convergence cone half-angle, Theta, is set at a value that is determined by tradeoffs among economic and physical factors. Factors driving a low value of Theta are dispersion, aberrations, magnet costs, reactor economics, shielding and beam-line vacuum. Factors driving a large value of Theta are the emittance limit, space charge limits, and jitter control. The typical range of reactor values (Theta = 5-20 mr) is the result of compromise among these factors. Aside from the spot size condition, it is desired to make the normalized emittance relatively large (epsilon/sub n/ = $\beta\gamma$ epsilon > 10^{-5} m-r) since transportable current is found to vary as epsilon/sub n//sup 2/3/, and too small a value of epsilon/sub n/ could result in an unreasonably large number of beamlets in the high energy portion of the linac (N increasing above ~ 24).

20371 (LA—11141-MS-Vol.2, pp 4.2.1-4.2.2) **Beam neutralization physics.** Magelssen, G.R. Dec 1987. NTIS, PC A18/MF A01. Order Number DE88005082/JAW.

In HIFSA: Heavy-Ion Fusion Systems Assessment Project: Volume 2, Technical analyses.

The beam transport problem has a great need for experimental and theoretical support. From an experimental standpoint, an intense and cold intermediate - to - heavy high-z ion beam is needed. Unfortunately, light-ion machines create beams with very large momentum spreads. As a result, the streaming instability growth rates are greatly reduced. Furthermore, these beams can only propagate in background pressures above 1 torr, and so, many neutralization physics issues would remain unresolved. Finally, the atomic plasma physics issues related to heavy ions could not be addressed. The only beam development program that the author is aware of that could someday address these transport issues is being built at GSI, West Germany.

20372 (LA—11141-MS-Vol.2, pp 5.1.1-5.1.60) **Heavy-ion fusion reactors.** Pendergrass, J.H. Dec 1987. NTIS, PC A18/MF A01. Order Number DE88005082/JAW.

In HIFSA: Heavy-Ion Fusion Systems Assessment Project: Volume 2, Technical analyses.

The requirements, the desirable characteristics, the tradeoffs, and the design constraints are discussed for commercial heavy-ion fusion (HIF) reactor plants with induction linear-accelerator (linac) drivers. The tradeoffs and the design constraints when the reactor plant requirements and desirable characteristics conflict with those for other HIF power plant systems are described. The reactor plant concepts included in the Heavy-Ion Fusion Systems Assessment (HIFSA) are discussed in relation to these requirements, characteristics, tradeoffs, and constraints. Four reactor-plant concepts were included in the HIFSA studies to provide large ranges of reactor repetition rate and target yield accommodation (1 to 20 Hz and 150 to 3000 MJ). This permitted thorough exploration of the impact on HIF cost of electricity (COE) of the high repetition rate and efficiency advantages of induction linacs. Contrary to pre-HIFSA expectations, large plants with large driver repetition rates and multiple reactors are not required for attractive COE: repetition rates < 10 Hz in 1000-MWe, one-reactor plants are competitive. More than one HIF reactor plant concept shows promise: the minimum COE estimates for the four concepts in 1000-MWe plants range from 55 to 75 mills/kWh. Cost and/or technological problems in one part of reactor operating parameter space need not be fatal for HIF: the COE is within 5% of the minimum over wide ranges of the repeti-

tion rate and the target yield for a fixed plant size and reactor concept.

20373 (LA—11141-MS-Vol.2, pp 5.2.1-5.2.3) **Reactor systems and balance of plant.** Zuckerman, D.S.; Driemeyer, D.E.; Waganer, L.M. (McDonnell Douglas Astronautics Co.). Dec 1987. NTIS, PC A18/MF A01. Order Number DE88005082/JAW.

In HIFSA: Heavy-Ion Fusion Systems Assessment Project: Volume 2, Technical analyses.

Requirements for several reactor and balance of plant systems are briefly reviewed. Reactor systems discussed are: target handling, injection and tracking systems; tritium recovery and waste treatment facilities; and power conversion systems. Among the balance of plant items considered are: buildings, vacuum systems and cooling systems.

20374 (LA—11141-MS-Vol.2, pp 6.1.1-6.1.57) **HIFSA systems integration and parametric studies.** Driemeyer, D.E.; Waganer, L.M.; Zuckerman, D.S.; Dudziak, D.J. (McDonnel Douglas Astronautics Co.). Dec 1987. NTIS, PC A18/MF A01. Order Number DE88005082/JAW.

In HIFSA: Heavy-Ion Fusion Systems Assessment Project: Volume 2, Technical analyses.

The basic intent of the DOE HIFSA project was to identify and evaluate promising technical innovations for their potential to enhance the economic attractiveness of an LIA-driven HIF power plant. The participants were thus proscribed from concentrating on a single conceptual design. Rather, they were directed to assess a broad spectrum of system options. From the beginning of the HIFSA project, the project team realized that it would be critical to examine the interactions between the various major reactor systems (e.g. driver, target and cavity) in order to determine the best combination of system design parameters. There was an early realization that each system design group should not independently optimize its own system. Rather, the best overall reactor design would consist of a set of compromises between the various systems. In essence, the individual strengths of the different systems would have to be traded off in order to create the best overall power plant design. This paper describes the models developed to assess system design and reports the conclusions of the studies.

20375 (LA—11141-MS-Vol.2, pp 6.1A.1-6.1A.20) **ICCOMO cost scaling equations.** Driemeyer, D.E.; Waganer, L.M.; Zuckerman, D.S. (McDonnel Douglas Astronautics Co.). Dec 1987. NTIS, PC A18/MF A01. Order Number DE88005082/JAW.

In HIFSA: Heavy-Ion Fusion Systems Assessment Project: Volume 2, Technical analyses.

The key figure of merit for the assessment of the HIF system options has been established as the cost of electricity (COE). The cost of electricity is estimated by incorporating a consistent and compatible set of candidate options into a heavy-ion fusion reactor power plant. These options are defined in a modular manner to allow substitution of each system option and an estimate of performance and cost impacts. Appropriate interface requirements are incorporated as a part of the modeling. The logic and the supporting data for the generation of the HIFSA capital cost estimates are presented. Factors that determine and influence the capital costs are presented. The approach to the cost and performance estimation for the HIFSA project is based upon the use of a standard or reference fusion electric power plant within which the various system options could be examined. All systems, equipment, buildings, and site facilities have a common design and cost basis. Subsections define in detail each of the major cost accounts.

20376 (LA—11141-MS-Vol.2, pp 6.1B.1-6.1B.56) **Source listing of inertial confinement systems and cost model (ICCOMO).** Driemeyer, D.E.; Waganer, L.M.; Zuckerman, D.S. (McDonnel Douglas Astronautics Co.). Dec 1987. NTIS, PC A18/MF A01. Order Number DE88005082/JAW.

In HIFSA: Heavy-Ion Fusion Systems Assessment Project: Volume 2, Technical analyses.

This appendix provides a complete listing of the ICCOMO source code. The first five pages contain a list of all the input variables, along with their allowable values; a list of the input and output files; and a list of all subroutines in the code.

20377 (LA—11141-MS-Vol.2, pp 6.1C.1-6.1C.5) **Sample input and output files for ICCOMO.** Driemeyer, D.E.; Waganer, L.M.; Zuckerman, D.S. (McDonnel Douglas Astronautics Co.). Dec 1987. NTIS, PC A18/MF A01. Order Number DE88005082/JAW.

In HIFSA: Heavy-Ion Fusion Systems Assessment Project: Volume 2, Technical analyses.

A sample input file (ICF.DAT), the resulting output summary file (ICF.SUM), and the sixth case of the annotated output file (ICF.OUT) are presented. Definition of all the input variables in ICF.DAT can be found in the first few pages of the ICCOMO code listing (Appendix 6B). The structure of the database output file (ICF.DBF) can be found in Appendix 6D.

20378 (LA—11141-MS-Vol.2, pp 6.1D.1-6.1D.5) **ICCOMO database output file (ICF.DBF) structure.** Driemeyer, D.E.; Waganer, L.M.; Zuckerman, D.S. (McDonnell Douglas Astronautics Co.). Dec 1987. NTIS, PC A18/MF A01. Order Number DE88005082/JAW.

In HIFSA: Heavy-Ion Fusion Systems Assessment Project: Volume 2, Technical analyses.

The following pages present the dBASE III structure for the ICCOMO database file (ICF.DBF) output. The ICF.DBF file is converted to dBASE III by first creating a dBASE file with the accompanying structure and then appending the ICF.DBF file to it (dBASE III command: APPEND FROM ICF.DBF DELIMITED).

20379 (LA—11141-MS-Vol.2) **HIFSA: Heavy-Ion Fusion Systems Assessment Project: Volume 2, Technical analyses.** Dudziak, D.J. (ed.). (Los Alamos National Lab., NM (USA)). Dec 1987. Contract W-7405-ENG-36. 420p. NTIS, PC A18/MF A01; 1; GPO Dep. Order Number DE88005082/JAW.

A two-year project was undertaken to assess the commercial potential of heavy-ion fusion (HIF) as an economical electric power production technology. Because the US HIF development program is oriented toward the use of multiple-beam induction linacs, the study was confined to this particular driver technology. The HIF systems assessment (HIFSA) study involved several subsystem design, performance, and cost studies (e.g., the induction linac, final beam transport, beam transport in reactor cavity environments, cavity clearing, target manufacturing, and reactor plant). In addition, overall power plant systems integration, parametric analyses, and tradeoff studies were performed using a systems code developed specifically for the HIFSA project. Systems analysis results show values for cost of electricity (COE) comparable to those from other inertial- and magnetic-confinement fusion plant studies; viz., 50 to 60 mills/kWh (1985 dollars) for 1-GWe plant sizes. Also, significant COE insensitivity to major accelerator, target, and reactor parameters near the minima was demonstrated. Conclusions from the HIFSA study have already led to substantial modifications of the US HIF research and development program. Separate abstracts were prepared for 17 papers in these analyses.

20380 (LA-UR—88-154) **Recent progress on the Los Alamos Aurora ICF [inertial confinement fusion] laser system.** Rosocha, L.A.; Blair, L.S. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 13p. (CONF-871254—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005387/JAW.

From Lasers '87; Lake Tahoe, NV, USA (7 Dec 1987).

Aurora is the Los Alamos short-pulse, high-power, krypton-fluoride laser system. It serves as an end-to-end technology demonstration prototype for large-scale ultraviolet laser systems for short wavelength inertial confinement fusion (ICF) investigations. The system is designed to employ optical angular multiplexing and serial amplification by electron-beam-driven KrF laser amplifiers to deliver stacked, 248-nm, 5-ns duration multikilojoule laser pulses to ICF-relevant targets. This paper presents a summary of the Aurora system and a discussion of the progress achieved in the construction and integration of the laser system. We concentrate on the main features of the following major system components: front-end

lasers, amplifier train, multiplexer, optical relay train, demultiplexer, and the associated optical alignment system. During the past year, two major construction and integration tasks have been accomplished. The first task is the demonstration of 96-beam multiplexing and amplified energy extraction, as evidenced by the integrated operation of the front end, the multiplexer (12-fold and 8-fold encoders), the optical relay train, and three electron-beam-driven amplifiers. The second task is the assembly and installation of the demultiplexer optical hardware, which consists of over 300 optical components ranging in size from several centimeters square to over a meter square. 13 refs., 13 figs.

20381 **(LA-UR—88-260) ICF research at Los Alamos.** Goldstone, P.D.; Ackerhalt, J.R.; Blair, L.S.; Cartwright, D.C.; Foreman, C.A.; Hauer, A.; Hanson, D.E.; Hoffer, J.K.; Kristal, R.; Fenstermacher, C.A. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 28p. (CONF-871093—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005394/JAW.

From 8. international workshop on laser interaction and related plasma phenomena; Monterey, CA, USA (27 Oct 1987).

It is apparent that short wavelength lasers (<500 nm) provide efficient coupling of laser energy into ICF target compression. KrF lasers (248 nm) operate at near-optimum wavelength and provide other potential benefits to ICF target coupling (e.g., bandwidth) and applications (high wallplug efficiency and relatively low cost). However, no driver technology has yet been shown to meet all of the requirements for a high-gain ICF capability at a currently acceptable cost, and there are still significant uncertainties in the driver-target coupling and capsule hydrodynamics that must be addressed. The Los Alamos research program is designed to assess the potential of KrF lasers for ICF and to determine the feasibility of achieving high gain in the laboratory with a KrF laser driver. Major efforts in KrF laser development and technology, target fabrication and materials development, and laser-matter interaction and hydrodynamics research are discussed. 27 refs., 10 figs.

20382 **(SAND—87-2863C) Relationship between the TDF [Target Development Facility] and commercial ICF [inertial confinement fusion] drivers.** Olson, R.E. (Sandia National Labs., Albuquerque, NM (USA)). 1987. Contract AC04-76DP00789. 23p. (CONF-871173—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005168/JAW.

From 3. ICF system and applications colloquium; Madison, WI, USA (9 Nov 1987).

The Target Development Facility (TDF) is envisioned as a testbed for the development of high gain inertial confinement fusion (ICF) targets. A 10 MJ, 300 to 1000 TW light ion TDF driver concept based upon extrapolations from present-day pulsed power technology is described in the present paper. This description is followed by a discussion of the relevance of TDF technology to the eventual commercialization of ICF.

20383 **(UCRL—96710) Design issues for a laboratory high gain fusion facility.** Hogan, W.J. (Lawrence Livermore National Lab., CA (USA)). 2 Nov 1987. Contract W-7405-ENG-48. 5p. (CONF-871007—78). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004406/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

In an inertial fusion laboratory high gain facility, experiments will be carried out with up to 1000 MJ of thermonuclear yield. The experiment area of such a facility will include many systems and structures that will have to operate successfully in the difficult environment created by the sudden large energy release. This paper estimates many of the nuclear effects that will occur, discusses the implied design issues and suggests possible solutions so that a useful experimental facility can be built. 4 figs.

20384 **(UCRL—96771) Preparation of multilayered x-ray photoabsorption targets.** Weed, J.W. (Lawrence Livermore National Lab., CA (USA)). 16 Dec 1987. Contract W-7405-ENG-48. 5p. (CONF-880110—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004715/JAW.

From SPIE O-E Lase '88: optoelectronics and laser applications in science and engineering; Los Angeles, CA, USA (10 Jan 1988).

Free standing targets were produced to measure the sub-keV photoabsorption cross section of numerous elements. The targets were fabricated with a computer controlled, magnetron sputter deposition system. The targets are structured of multiple layers of a given element interspersed with layers of carbon. The purpose of the multilayering is twofold: to improve the mechanical strength and to protect the given element from exposure to the atmosphere, using the outermost C layers as a seal. The targets are 1.9 cm in diameter and their thicknesses range from 160 nm to 4000 nm depending upon the element selected for the given experiment. The total thickness of the C layers in each target is a maximum of 200 nm. The first and last C layers (the sealing layers) are 50 nm thick and the remaining C is divided among the interspersed layers. Multilayer targets were successfully produced in which the given element was either Al, Ti, V, C, Cr, Ni, Cu, Si, or Au. Areal density and Rutherford backscatter measurements were performed to accurately establish the total amount of the deposited elements. 2 refs., 4 figs.

20385 **(UCRL—96821) The stability of free-electron lasers against filamentation.** Barnard, J.J.; Scharlemann, E.T.; Yu, S.S. (Lawrence Livermore National Lab., CA (USA)). 15 Sep 1987. Contract W-7405-ENG-48. 15p. (CONF-8709140—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004712/JAW.

From 9. international free electron laser conference; Williamsburg, VA, USA (14 Sep 1987).

In inertial confinement fusion (ICF) experiments, the high electromagnetic fields propagating through a relatively dense plasma can result in a transverse instability, causing the matter and light to form filaments oriented parallel to the light beam. We examine whether a similar instability exists in the electron beam of a free-electron laser, where such an instability could interfere with the transfer of beam kinetic energy into optical wave energy. We heuristically examine the instability in a relativistic beam through which an intense laser beam is propagating. We ignore the FEL effects. We estimate how the altered index of refraction in an FEL affects the dispersion relation. Finally, we estimate the effect that the instability could have on the phase coherence of a particle as it transits an FEL. 10 refs., 2 tabs.

20386 **(UCRL—97492) High Z interaction physics on Nova.** Kania, D.R.; Albritton, J.; Hatcher, B.; Kauffman, R.; Kornblum, H.; Langer, S.; Lasinski, B.; Glendinning, G.; Phillion, D.; Suter, L. (Lawrence Livermore National Lab., CA (USA)). Aug 1987. Contract W-7405-ENG-48. 13p. (CONF-8708110—30). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004397/JAW.

From 31. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA, USA (16 Aug 1987).

A detailed understanding of the interaction of laser light with high Z materials is important for the development of indirect drive inertial confinement fusion. To improve our understanding of the interaction of 0.35 μm light at intensities between 10^{14} and 10^{15} W/cm^2 with high Z materials, we have performed a variety of experiments to address important physics issues. Hydrodynamics and ablation, transport processes, and x-ray conversion have been studied with thin Au dot targets and Au and Be mixture targets. 2 refs., 5 figs.

20387 **(UCRL—97954) No pain-no gain: The complex art of soft x-ray laser target design and analysis.** Rosen, M.D.; London, R.A.; Hagelstein, P.L.; Maxon, M.S.; Eder, D.C.; Whitten, B.L.; Chen, M.H.; Nash, J.K.; Scofield, J.H.; Hazi, A.U. (Lawrence Livermore National Lab., CA (USA)). 12 Jan 1988. Contract W-7405-ENG-48. 20p. (CONF-8710265—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005480/JAW.

From Conference on atomic processed in plasma; Santa Fe, NM, USA (1 Oct 1987).

We review our methodologies in the design and analysis of soft x-ray laser experiments. We convolve large-scale 2-D hydro code output with detailed atomic data bases in a kinetics code with 1-D or 2-D line transfer. The time and space dependent level population data is then post processed further with a beam transport

code, including refraction, to predict actual experimental results. While mysteries do remain, we present many examples that show how this complex modeling procedure is crucial in explaining experimental results. 23 refs., 8 figs., 1 tab.

20388 **Thermal transport studies of 351-nm laser-produced plasmas using extreme ultraviolet spectroscopy.** Moreno, J.C.; Griem, H.R.; Goldsmith, S.; Krumbein, A.; Epstein, R.; Jaanimagi, P.A.; Richardson, M.C.; Yaakobi, B. (Laboratory for Plasma and Fusion Energy Studies, University of Maryland, College Park, Maryland 20742). *Journal of Applied Physics;* **63**: No. 3, 674-680(1 Feb 1988).

Spectra from an extreme ultraviolet (XUV) grazing incidence spectrograph have been used in the study of thermal transport in laser plasmas. These measurements with XUV lines allowed a diagnosis of much lower temperatures in the heating front than had been previously measured. The OMEGA (24-beam, 351-nm) laser system at the University of Rochester was used to produce plasmas from glass microballoons coated with Al or Ti substrates and overcoated with a plastic ablator. Thermal transport was investigated by measuring the intensity of x-ray and XUV lines as a function of the thickness of the plastic overcoat. These measurements were then compared to the 1D hydrodynamic code l-smcapsII-smcapsa-smcapsc-smcaps. Agreement between the hydrodynamic code and experiment could not be obtained with a reasonable value for the flux limiter ($f \leqq 0.65$). Consistent results were reached if nonuniform irradiation and flux inhibition is assumed. The measured burnthrough depths of around 9 μm are similar to previous measurements made with x-ray lines at fluxes below 10^{15} W/cm^2. No evidence of preheat in the heat front was observed.

20389 **Lithium-fluoride flashover ion source cleaned with a glow discharge and irradiated with vacuum-ultraviolet radiation.** Burns, E.J.T.; Woodworth, J.R.; Bieg, K.W.; Mehlhorn, T.A.; Stygar, W.A.; Sweeney, M.A. (Pulsed Power Directorate, Sandia National Laboratories, Albuquerque, New Mexico 87185). *Journal of Applied Physics;* **63**: No. 1, 11-27(1 Jan 1988). Contract AC04-76DP00789.

We have studied methods of varying the ion species generated by a lithium-fluoride overcoated anode in a 0.5-MV magnetically insulated ion diode. We found that cleaning the anode surface with a 13.6-MHz rf glow discharge or illuminating the anode with a pulsed soft x-ray, vacuum-ultraviolet (XUV) radiation source just before the accelerator pulse significantly altered the ion species of the ion beam produced by the diode. The glow-discharge plasma removed adsorbates (carbon, hydrogen, and oxygen) from the surface of the LiF flashover source. The ions seen were lithium and hydrogen. Unfortunately, the diode impedance with a lithium-fluoride anode was high and the ion efficiency was low; however, XUV irradiation of the surface dramatically lowered the impedance by desorbing neutrals from the ion source via photon-stimulated desorption. Current densities of ten times the Child—Langmuir space-charge limit were achieved under XUV irradiation. In particular, ion currents increased by over a factor of 3 when 12 mJ/cm^2 of XUV radiation was used. However, with XUV irradiation the largest fraction of ions were fluorine, oxygen, carbon, and hydrogen, not lithium.

20390 **Amplification of sound waves in an imploding plasma shell: Exact results.** Han, S.J. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *A: General Physics;* **37**: No. 1, 207-210(1 Jan 1988).

In an extended model, a rigorous proof is given for sound-wave amplifications in an imploding plasma shell. It is shown that, in the absence of a massless free surface, the boundary conditions give the exact eigenvalues which determine the asymptotic solution to the problem.

20391 **Optimization of the sputter-deposition process for preparing smooth coatings of beryllium on microspherical substrates.** Chen, C.W.; Alford, C.S. (Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 1, 128-133(Jan 1988). Contract W-7405-ENG-48.

The process of physical vapor deposition of beryllium by magnetron sputtering is studied in broad terms of major operational parameters. Optimal conditions are established for the preparation of Be coatings on glass microspheres. The coatings prepared in both dc and rf modes displayed 200—300 A surface finish. Such superior surface finish is made possible by the application of a modest, negative bias voltage to the substrate that suppresses columnar growth and promotes nucleation as a result of resputtering.

20392 **Effect of spontaneous emission in hydrogenlike magnesium and aluminum x-ray laser schemes.** Eder, D.C.; Rosen, M.D.; Lee, R.W.; Trebes, J.E.; Ceglio, N.M.; Eckart, M.J.; Kauffman, R.L.; MacGowan, B.J.; Matthews, D.L. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Journal of the Optical Society of America B: Optical Physics;* **4**: No. 12, 1949-1953(Dec 1987). Contract W-7405-ENG-48.

Two-dimensional modeling of magnesium exploding-foil experiments shows that spontaneous emission from regions outside of line focus makes the measurement of induced emission and gain difficult. An improved target design is proposed that solves the spontaneous-emission problem by replacing the foil by a ribbon. The new targets consist of an aluminum ribbon on a Formvar sheet with the potential 4—3 lasing line at III A for H-like Al. We comment on what conditions are required for lasing in the 3—2 line of H-like Al at 39 A.

20393 **KMSF low preheat implosion experiments.** Larsen, J.T.; Johnson, R.R. (KMS Fusion, Inc., Ann Arbor, MI 48106). *AIP (American Institute of Physics) Conference Proceedings;* **160**: No. 1, 42-44(25 Sep 1987). (CONF-861038—).

From OSA/APS international laser science conference; Seattle, WA, USA (20 Oct 1986).

Laser-driven inertial confinement fusion (ICF) experiments are being performed at several laboratories throughout the world. Nearly all are seeking to demonstrate compressed fuel densities of several tens g/cm^3. For ICF to be an efficient process, it is desirable to compress the fuel along a near-Fermi degenerate adiabat to densities of several hundred g/cm^3. Addition of thermal energy prior to achieving the compressed state is detrimental in that a significantly larger driver would be required to achieve ignition. Preheating of the fuel prior to compression may result from radiation or thermal electron conduction, or non-isentropic processes such as shock heating. Recent experiments at KMSF sought to control these by a combination of target and laser parameters. Using a spherical illumination system, the target is irradiated with a carefully prescribed temporal pulse of frequency doubled neodymium glass laser light. Low preheat targets are designed with thick polymer (poly vinyl alcohol) shells and cryogenic fuel layers. The implosion process is recorded by a number of optical and x-ray diagnostics. A four-frame holographic interferometer records the temporal evolution of the ablated plasma while an x-ray pinhole camera records the symmetry of the compressed core. The most important diagnostic is the combined x-ray backlighter/streak camera combination which records the implosion trajectory in one dimension. A comparison of the data from these three major instruments with the results from the hydrodynamic simulation code allows one to interpret the final state the fuel reached and thus, the preheat level. Assuming spherical symmetry, record fuel densities in excess of 35 g/cm^3 have been achieved.

20394 **Neutral particle beam distributed data acquisition system.** Daly, R.T.; Kraimer, M.R.; Novick, A.H. (Argonne National Lab., 9700 S. Cass Avenue, Argonne, IL 60439). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 816-821(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

A distributed data acquisition system has been designed to support experiments at the Argonne Neutral Particle Beam Accelerator. The system uses a host VAXstation II/GPX computer acting as an experimenter's station linked via Ethernet with multiple MicroVAX IIs and rtVAXs dedicated to acquiring data and controlling hardware at remote sites. This paper describes the hard-

ware design of the system, the applications support software on the host and target computers, and the real-time performance.

20395 **Plasma-wall interaction: Recent TFTR results and implications on design and construction of limiters.** Owens, D.K.; Ulrickson, M.A. (Princeton Univ., Plasma Physics Lab., P.O. Box 451, Princeton, NJ 08544). pp 61-74 of Fusion technology 1986. Elmsford, NY; Pergamon Books Inc. (1987). (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

The first wall of the Tokamak Fusion Test Reactor (TFTR) consists of a water cooled toroidal belt limiter, a cooled moveable limiter, and cooled protective plates to shield the vacuum vessel from neutral beam shinethrough. Each of these systems consists of Inconel support plates covered with graphite tiles. In addition, there are Inconel and stainless steel bellows cover plates to protect the bellows and the surface pumping system which provides enhanced pumping in the torus and also serves to protect the bellows. These systems are described and the design requirements, simulations and actual thermal and mechanical loads reviewed. The normal and off-normal operating conditions which were considered in the design of the TFTR components include thermal loading during normal and disruptive plasma operation, eddy-current induced mechanical forces and arcing. The failures which have occurred are generally associated with thermal stress rather than mechanical failure due to disruption induced eddy currents. The models which were developed to design the TFTR hardware appear to have worked well as the performance of these systems has generally been satisfactory at loads approaching design limits. The implications of the TFTR experience for reactor design are discussed.

20396 **Inertial fusion research at Lawrence Livermore National Laboratory: Program status and future applications.** Meier, W.R.; Hogan, W.J. (Lawrence Livermore National Lab., Livermore, CA). pp 93-98 of Emerging nuclear energy systems. Velarde, G.; Minguez, E. Teaneck, NJ; World Scientific Pub. Co. (1987). (CONF-860601—). Contract W-7405-ENG-48.

From 4. international conference on emerging nuclear energy systems; Madrid, Spain (30 Jun 1986).

The objectives of the Lawrence Livermore National Laboratory (LLNL) Laser Fusion Program are to understand and develop the science and technology required to utilize inertial confinement fusion (ICF) for both military and commercial applications. The results of recent experiments are described. The authors point out the progress in their laser studies, where they continue to develop and test the concepts, components, and materials for present and future laser systems. While there are many potential commercial applications of ICF, the authors limit their discussions to electric power production.

20397 **Overview of the heavy ion fusion accelerator research program at the U.S. Department of Energy.** Gajewski, R. (Division of Advanced Energy Projects, Office of Basic Energy Sciences, U.S. Department of Energy, Washington, D.C. 20545). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 20-22(21 Jan 1986). (CONF-860510—).

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

A brief description is given of the Heavy Ion Fusion Accelerator Research program at the U.S. Department of Energy from a management perspective. Included are the rationale for support, budgetary considerations, and an overview of the current and proposed programs.

20398 **Experiments and prospects for induction linac drivers.** Keefe, D. (Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 63-73(21 Jan 1986). (CONF-860510—). Contract AC03-76SF00098.

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

In the last three years, the U.S. program in Heavy Ion Fusion has concentrated on understanding the induction linac approach to a power-plante driver. In this method it is important that the beam current be maximized throughout the accelerator. Consequently, it is crucial to understand the space-charge limit in the AG transport system in the linac and, also, to achieve current amplification during acceleration to keep pace with the kinematical increase of this limit with energy. Experimental results on both these matters and also on the use of multiple beams (inside the same accelerating structure) will be described.

20399 **Review of target studies for heavy ion fusion.** Lindl, J.D.; Bangerter, R.O.; Mark, J.W.; Pan, Y. (Lawrence Livermore National Laboratory, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 89-99(21 Jan 1986). (CONF-860510—). Contract W-7405-ENG-48.

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

We present an updated set of gain curves for radiation driven ion beam targets. The improved target performance calculated with nuclear spin polarized fuel will also be discussed. We discuss the conditions required for efficient conversion to x-rays of ion beam energy. These requirements are compared with those obtained for lasers. Recent results on symmetry requirements for direct drive ion beam targets are presented.

20400 **Heavy ion fusion systems assessment study.** Dudziak, D.J.; Herrmannsfeldt, W.B. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 111-125(21 Jan 1986). (CONF-860510—). Contract AC03-76SF00515.

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

The Heavy Ion Fusion Systems Assessment (HIFSA) study was conducted with the specific objective of evaluating the prospects of using induction linac drivers to generate economical electrical power from inertial confinement fusion. The study used algorithmic models of representative components of fusion system to identify favored areas in the multidimensional parameter space. The results show that cost-of-electricity (COE) projections are comparable to those from other (magnetic) fusion scenarios, at a plant size of 1000 MWe. These results hold over a large area of parameter space, but depend especially on effecting savings in the cost of the accelerator by using ions with a charge-to-mass ratio about three times higher than has been usually assumed. The feasibility of actually realizing such savings has been shown: (1) by experiments showing better-than-previously-assumed transport stability for space charge dominated beams, and (2) by theoretical predictions that the final transport and compression of the pulse to the target pellet, in the expected environment of a reactor chamber, may be sufficiently resistant to instabilities, in particular to streaming instabilities, to enable neutralized beams to successfully propagate to the target. Neutralization is assumed to be required for the higher current pulses that result from the use of the higher charge-to-mass ratio beams jointly by the Lawrence Berkeley Laboratory, the Lawrence Livermore National Laboratory, and the Los Alamos National Laboratory, and also by the McDonnell Douglas Astronautics Company with funding from the Electric Power Research Institute.

20401 **Preliminary results from MBE-4: A four beam induction linac for heavy ion fusion research.** Fessenden, T.J.; Judd, D.L.; Keefe, D.; Kim, C.; Laslett, L.J.; Smith, L.; Warwick, A.I.; Warwick, P.b.A.I. (Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 145-155(21 Jan 1986). (CONF-860510—). Contract AC03-76SF00098.

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

Preliminary results are presented from a scaled experimental multiple beam induction linac. This experiment is part of a program of accelerator research for heavy ion fusion. It is shown that multiple beams can be accelerated without significant mutual interaction. Measurements of the longitudinal dynamics of a current-amplifying induction linac are presented and compared to calculations. Coupling of transverse and longitudinal dynamics is discussed.

20402 **Emittance growth from charge density changes in high-current beams.** Wangler, T.P.; Crandall, K.R.; Mills, R.S. (Los Alamos National Laboratory, MS H817 Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 166-185(21 Jan 1986). (CONF-860510—).

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

We use the relation between field energy and rms emittance, together with the property of charge-density homogenization for intense nonuniform beams in linear focusing systems, to derive equations for emittance growth and minimum final emittance. We discuss three problems in which this charge redistribution mechnism is isolated: the 1-D continuous sheet beam, the 2-D continuous round beam, and the 3-D spherical bunch. For each of the three problems, we identify and compare scaling parameters tha determine the emittance growth and minimum final emittance as a function of beam current, emittance, and external focusing strength. Numerical simulations are used to test the equations, to show that the charge redistribution mechanism results in very rapid emittance growth, and to study the detailed time evolution of the beams.

20403 **Maryland transport experiment: General perspectives and recent results with off-centered beams.** Reiser, M.; McAdoo, J.; Kehne, D.; Low, K.; Lawson, J.D.; Prior, C.R. (Electrical Engineering Department and Laboratory for Plasma and Fusion Energy Studies, University of Maryland, College Park, MD 20742). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 186-206(21 Jan 1986). (CONF-860510—).

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

The experiment at the University of Maryland was designed to study the physics of space-charge-dominated beam transport through a periodic focusing channel. Its major goal is to check theoretical predictions of current limits and instabilities and to investigate the effects of nonlinear lens forces, misalignments, and beam off-centering. In the recently completed second phase, a 5 kV, 180—200 mA electron beam is transported through 36 equally spaced solenoid lenses. The focusing strength of the channel is measured in terms of the phase shift $\sigma/\text{sub } o/$ without space charge. Below $\sigma/\text{sub } o/ = 50°$, the focusing is too weak to confine the beam within the pipe. Between 60° and 80° a 'window' of lossless transmission is observed. Above $\sigma/\text{sub } o/ = 80°$, the transported current begins to drop. The structure of the transmission curve versus $\sigma/\text{sub } o/$ in this fall-off region is not smooth, and is very sensitive to alignment errors of the gun and of individual magnets. Results are compared with computer simulations. The potential of the experiment and expected roles of instabilities, nonlinearities, and errors will be discussed.

20404 **Intense metal ion beam source for HIF.** Brown, I.G. (Lawrence Berkeley Laboratory, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 207-214(21 Jan 1986). (CONF-860510—).

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

We have developed an ion source which can produce high current beams of metal ions. The source uses a metal vapor vacuum arc discharge as the plasma medium from which the ions are extracted, so we have called this source the MEVVA ion source. The metal plasma is created simply and efficiently and no carrier gas is required. Beams have been produced from metallic elements spanning the periodic table from lithium through uranium, at extraction voltages from 10 to 60 kV and with beam currents as high as 1.1 Amperes (electrical current in all charge states).

20405 **HIF transport issues for $P>10^{-3}$ Torr and $Z>1$.** Olson, C.L. (Sandia National Laboratories, Albuquerque, New Mexico 87185). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 215-226(21 Jan 1986). (CONF-860510—). Contract AC04-76DP00789.

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

Final transport schemes for HIF are examined, with emphasis on transport for $p>10^{-3}$ Torr and $Z>1$ since this should simplify the reactor design and reduce the length of the accelerator. Specifically the question of charge neutralization is addressed. We find (1) the fractional neutralization f needed scales as $f/\text{sub } i/ = (1-Z^{-2})$ which means $f/\text{sub } i/>0.89$ is needed for $Z>3$; (2) axially-trapped electrons limit the net beam potential to $ephi/\text{sub min}/ = \alpha(1/2\ m/\text{sub } e/v/\text{sub } i/^2)$ with $1\leqq\alpha\text{approx.} <4$; (3) radially-expelled plasma ions increase $f/\text{sub } i/$ especially near the pellet; (4) radially-oscillating plasma electrons have and adiabatic limit of $f/\text{sub } i/\cong 0.5$; and (5) as $f/\text{sub } i/$ approaches unity, plasma particle trajectories may involve drift motions along and radially away from the ion beam. Also, criteria are given for the maximum Z/A allowed for transporting very large currents. For the HIF parameters used, it appears that neutralization will probably be adequte for $Z\text{approx.} <3$.

20406 **Studies on longitudinal beam compression in induction accelerator drivers.** Mark, J.W.; Ho, D.D.; Brandon, S.T.; Chang, C.; Drobot, A.T.; Faltens, A.; Lee, E.P.; Krafft, G.A. (Science Applications Inc., McLean, VA 22102 USA). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 227-236(21 Jan 1986). (CONF-860510—).

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

Longitudinal beam compression is an integral part of the U.S. induction accelerator development effort for heavy ion fusion. It occurs before final focus and fusion chamber beam transport and is a key process determining initial conditions for final focus hardware. Determining the limits for maximal performance of key accelerator components is an essential element of the effort to reduce driver costs. We outline here studies directed towards defining the limits of final beam compression including considerations such as: maximal available compression, effects of longitudinal dispersion and beam emittance, combining pulse-shaping with beam compression to reduce the totial number of beam manipulations, etc. We summarize inital results on these limits gleaned from a survey including already more than 30 runs of 20—30 minutes each on our Cray computers.

20407 **Threshold for emittance growth of A-G focused intense beams.** Haber, I. (Naval Research Laboratory, Washington, DC 20275). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 236-242(21 Jan 1986). (CONF-860510—).

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

The behavior of an intense beam propagating in a long alternate-gradient focusing channel is examined using computer simulations to determine, for phase advances between 60° and 90°, the emittance growth which might be expected to result from space charge nonlinearities and instabilities.

20408 **Longitudinal compression of heavy-ion beams with minimum requirements on final-focus.** Ho, D.D.; Bangerter, R.O.; Mark, J.W.; Brandon, S.T.; Lee, E.P. (Lawrence Livermore National Laboratory, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 243-252(21 Jan 1986). (CONF-860510—). Contract W-7405-ENG-48.

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

A method is developed to compress a heavy-ion beam longitudinally in such a way that the compressed pulse has a constant line-charge density profile and uniform longitudinal momentum. These conditions may be important from the standpoint of final focusing. By realizing the similarity of the equations that describe the 1-D charged-particle motion to the equations that describe 1-D ideal gas flow, the evolution of λ and the velocity tilt can be calculated using the method of characteristics developed for unsteady supersonic gasdynamics. Particle simulations confirm the theory. Various schemes for pulse shaping have been investigated.

20409 **Some mechanisms and time scales for emittance growth.** Anderson, O.A. (Lawrence Berkeley Laboratory, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 253-263(21 Jan 1986). (CONF-860510—). Contract AC03-76SF00098.

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

We discuss several processes which affect transverse rms emittance and analyze the growth rate for two of them: (1) a fast process by which electrostatic self-field energy is converted into fluid motion, and (2) a slow process by which a nonlinear focusing force converts beam-size mismatch energy into additional emittance growth. The analysis for these two cases is done by solving the particle equation of motion. For the latter case we find that the final emittance depends primarily on the beam-size mismatch and that the time scale is inversely proportional to the nonlinearity parameter. We also discuss, in a more general way, another process by which wave-breaking in phase space causes partial conversion of fluid motion to quasi-thermal energy. In all cases, insight is gained by splitting the mean-square emittance into fluid-motion and quasi-thermal parts. Among other benefits, this allows a clearer understanding of the wave-breaking process.

20410 **Head-to-tail velocity tilt in an ion induction LINAC.** Kim, C.H.; Judd, D.L.; Laslett, L.J.; Smith, L.; Warwick, A.I. (Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 264-270(21 Jan 1986). (CONF-860510—). Contract AC03-76SF00098.

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

In the earlier stages of acceleration in a heavy-ion-induction linac, acceleration and bunching rates are constrained by the allowable value of head-to-tail velocity tilt at a given location. If focusing parameters at a given location are fixed, the velocity tilt should be less than a certain upper bound to avoid too much envelope variation and consequent beam losses. For space charge dominated beams, we found some favorable particle distributions in longitudinal phase space for which the maximum-matched-beam envelope at a given location is almost constant with respect to time, in spite of the presence of a large velocity tilt. Mismatch oscillations can be reduced by slow variation of the velocity tilt and slow current amplification. Under these circumstances, the velocity tilt can be as large as allowed by the usable range of σ_0. Behavior of Cs ion beams with very large velocity tilts (up to 40%) are studied experimentally in MBE-4 and the results are presented.

20411 **Simulation of transverse combining of space-charge dominated beams.** Celata, C.M. (Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 278-286(21 Jan 1986). (CONF-860510—). Contract AC03-76SF00098.

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

Rms emittance growth in the transverse plane due to the transverse combining of four identical elliptical beams of uniform density has been investigated. The emittance growth can be related by conservation of energy to the change in the electrostatic field energy. Its dependence on initial beam positions and radii has been calculated analytically for round beams and by computer simulation for elliptical beams.

20412 **Theory and simulation of emittance, space charge and electron pressure effects on focusig of neutralized ion beams.** Lemons, D.S.; Jones, M.E. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 287-294(21 Jan 1986). (CONF-860510—).

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

We investigate the final focus mode characterized by warm comoving electrons and vacuum propagation. In particular, we extend a previous envelope equation analysis of ion focusing in this mode to include the effects of ion emittance as well as ion space charge and initial electron temperature. Our major result is a simple equation relating initial R/sub o/ and final R/sub f/ beam radii to ion emittance ϵ and perveance K and electron Debye lengthe λ/sub D/ which is supported by one dimensional, electrostatic, particle-in-cell simulations of radial ion focusing. Finally, we use this equation to find the allowed temperature of neutralizing electrons for typical Heavy Ion Fusion reactor and High Temperature Experiment scenarios.

20413 **Grid-controlled metal ion sources for heavy ion fusion accelerators.** Len, L.K.; Humphries S. Jr.; Burkhart, C. (Institute for Accelerator and Plasma Beam Technology, University of New Mexico, Albuquerque, New Mexico 87131). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 314-322(21 Jan 1986). (CONF-860510—).

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

A variety of metal ions can be generated using vacuum arcs, but due to the nature of these arcs, the flux generated fluctuates in time. We have successfully employed electrostatically biased grids to control the plasma and to provide a well-behaved, space charge limited ion source. The grid prevents the plasma from entering the extraction gap before the main voltage pulse is applied. The extracte ion is space charge limited, resulting in a constant output current even though the ion flux from the vacuum arc source varies considerably. There are several advantages over conventional sources. For instance, thermionic sources are faced with heating problems for large area configurations, while gas-injection sources cause prefill problems because they take too long to reach equilibrium. We have performed extraction experiments with aluminum and indium arc sources. We have extracted 300 mA of pure Al^+ at 30 kV for 10 μs. The normalized beam emittance has been measured to be 3 x 10^{-7} π-m-rad.

20414 **Progress on the Los Alamos heavy-ion injector.** Wilson, D.C.; Riepe, K.B.; Ballard, E.O.; Meyer, E.A.; Shurter, R.P.; Van Haaften, F.W.; Humphries S. Jr. (Los Alamos National Laboratory, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 323-329(21 Jan 1986). (CONF-860510—).

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

Heavy-ion fusion using an induction linac requires injection of multiple high-current beams from a pulsed electrostatic accelerator at as high a voltage as practical. Los Alamos National Laboratory is developing a 16-beam, 2-MeV, pulsed electrostatic accelerator for Al^+ ions. The ion source will use a pulsed metal vapor arc plasma. A biased grid wil control plasma flux into the ion extraction region. This source has achieved a normalized emittance of ϵ/ sub n/ $<3\times10^{-7}\pi$-m-rad with Al^+ ions. An 800 kV Marx prototype with a laser fired diverter is being assembled. The ceramic accelerating column sections have been brazed and leak tested. Voltage hold off on a brazed sample was more than doubled by selective removal of the Ticusil braze fillet extending along the ceramic. A scaled test module held 250 kV for 50 μs, giving confidence that the full module can hold 175 kV per section. The pressure vessel should be received in June 1986. High-voltage testing of a 1 MV column will begin by early 1987.

20415 **Charge and current neutralization physics of a heavy ion beam during final transport.** Magelssen, G.R.; Forslund, D.W. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 330-337(21 Jan 1986). (CONF-860510—).

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

Heavy ion fusion requires high power to be focussed onto a small pellet. If the reactor chamber pressure is below 10^{-4}—10^{-5} Torr, beam compression will be limited by space charge unless neutralized by co-moving electrons. If higher chamber pressures are used, the heavy ion beam will create a significant number of background electrons during its propagation and will undergo stripping. The background electrons could provide the neutralization required for high beam intensities. In this paper we will focus on the physics associated with propagation through a fully ionized hydrogen plasma, so background electron generation is not included. One-dimensional electrostatic and two-dimensional fully electromagnetic particle-in-cell simulations are presented.

20416 Gain scaling laws for HIF. Magelssen, G.R. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 428-434(21 Jan 1986). (CONF-860510—).

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

The resltionship among target gain (thermonuclear energy-released/ion energy incident) and such factors as the total ion energy, the ion beam radius, the ion range, the ion power, the beam geometry, and the released target debris are critical in assessing the feasibility of a particular heavy ion inertial confinement fusion reactor concept.

20417 Substantial reductions of input energy and peak power requirements in targets for heavy ion fusion. Mark, J.W.; Pan, Y. (Lawrence Livermore National Laboratory, Livermore, California 94550). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 435-440(21 Jan 1986). (CONF-860510—). Contract W-7405-ENG-48.

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

We describe two ways of reducing the requirements of the heavy ion driver for ICF target implosion. Compared to our estimates of target gain not using these methods, the target input energy and peak power may be reduced by about a factor of two with the use of the hybrid-implision concept. Another factor of two reduction in input energy may be obtained with the use of spin-polarized DT fuel in the ICF target.

20418 Symmetry issues in a class of ion beam targets using sufficiently short direct drive pulses. Mark, J.W.; Lindl, J.D. (Lawrence Livermore National Laboratory, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 441-447(21 Jan 1986). (CONF-860510—). Contract W-7405-ENG-48.

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

Controlling asymmetries in direct drive ion beam targets depends upon the ability to control the effects of residual target asymmetries after an appropriate illumination scheme has already been utilized. We address a class of modified ion beam targets where residual asymmetries are ameliorated. The illumination scheme used is an axially symmetric one covenient for reactor designs. Residual asymmetries are controlled by limiting the radial motion of the radius R/sub dep/ of peak ion energy deposition. Limiting the motion of R/sub dep/ is achieved by lengthening the time scale t/sub s/ where changes in R/sub dep/ adversely affect asymmetries. In our example, t/sub s/ becomes longer than the duration Δt/sub D/ of the entire direct drive pulse train (t/sub s/ > Δt/sub D/).

20419 Accelerator and final focus model for an induction Linac based HIF system study. Lee, E.P. (Lawrence Berkeley Laboratory, University of California, Berkeley, CA 94720). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 461-473(21 Jan 1986). (CONF-860510—). Contract AC03-76SF00098.

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

An overview of the assumptions and models incorporated in the ongoing induction-Linac-based, HIF System Assessment is presented. Final transport, compression and final focus pose constraints which form a critical link between the accelerator and target requirements. A recent analysis has shown that system costs may be considerably reduced by the use of multiple charged ions. The assumptions underlying this direction are described.

20420 Cost of induction Linac drivers for inertial fusion for various target yields. Hovingh, J.; Brady, V.O.; Faltens, A.; Keefe, D.; Lee, E.P. (Lawrence Livermore National Laboratory, Box 808, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 474-481(21 Jan 1986). (CONF-860510—). Contract AC03-76SF00098.

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

The cost of induction linac accelerators for inertial fusion using mass 200 ions at a charge state of +3 for target yields of 300, 600, and 1200 MJ is presented. The ions are injected into the accelerator at 3 MV, and accelerated to the required voltage appropriate to the desired target yield. A cost comparison of the low voltage portion of the accelerator (3—50 MV) is made between a system with 64 and one with 16 superconducting quadrupoles. The design of the low voltage portion which yields the minimum-cost accelerator designs for several target yields and a fusion power of 3000 MW is presented.

20421 Survey of system options for heavy ion fusion. Waganer, L.M.; Driemeyer, D.E.; Zuckerman, D.S.; Billman, K.W. (McDonnell Douglas Astronautics Co., PO Box 516, St. Louis, MO 63166). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 482-488(21 Jan 1986). (CONF-860510—).

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

Several potentially attractive system options have been identified for use in a linear induction-driven heavy-ion fusion reactor power plant. These include higher charge-state ions, double-pulsed accelerators, a range of ion species, different target types, innovative cavity approaches and various illumination schemes. Data from the U.S. DOE Heavy-Ion Fusion (HIF) Systems Assessment (HIFSA) Project were integrated into a unified, comprehensive system performance and cost code for a commercial HIF power plant. This code surveyed the above hardware options over the design parameter spaces of multiple accelerator beams, target gain curve parameter (r/sup 3/2/R or r/R) gain, repetition rate, ion voltage, beam energy and net electric power output. The results indicate that a 1000 MWe, linac-driven, HIF power plant can produce electricity on a competitive basis. An innovative triple-charged heavy ion accelerator design is used that greatly reduces the cost (and length) of the accelerator while increasing the efficiency. The ability of the linac accelerator to operate efficiently at repetition rates of 5 to 1 Hertz indicates promise for reactor cavity protection cencepts such as granular and wetted wall.

20422 Performance and cost modeling of a linac-driven HIF power plant. Zuckerman, D.S.; Driemeyer, D.E.; Waganer, L.M.; Hovingh, J.; Lee, E.P.; Billman, K.W. (McDonell Douglas Astronautics Co., St. Louis, MO 63166). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 489-497(21 Jan 1986). (CONF-860510—).

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

A versatile and powerful systems analysis code has been written to assess the attractiveness of proposed induction linac-driven heavy-ion fusion (LIA-HIF) system options and aid in the assessment of R&D needs. This code was created as a part of the DOE-Sponsored Heavy-Ion Fusion Systems Assessment Project (HIFSA). The code is structured to enable investigation of a large and continuously variable design and operating parameter space. This was possible by modeling the systems with continuous algorithms which define all the necessary interface and system parameters. The code calculates and displays descriptive design, performance, and operational parameters along with the capital costs, annual costs, and cost of electricity. An overview of the code architecture is provided along with a discussion of its application and results.

20423 Influence of system optimization considerations on LIA drivers. Driemeyer, D.E.; Waganer, L.M.; Zuckerman, D.S. (McDonnell Douglas Astronautics Co., St. Louis, MO 63166). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 498-506(21 Jan 1986). (CONF-860510—).

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

The value of a systems and cost model lies in its capability to quickly evaluate plant cost and performance for various system/subsystem options an thus to assess the effect of potential design innovations and tradeoffs on the overall cost of electricity (COE). We have developed a Linear-Induction Accelerator driven Heavy-

ion Fusion (LIA-HIF) Inertial Confinement Systems and Costing Model (ICCOMO) as part of the Heavy-ion Fusion Systems Assessment Project (HIFSA). This code has been used to evaluate various combinations of driver, cavity, and target design alternatives in conjunction with one another to determine the cost-sensitivity of different system options and to identify the most promising designs. The most significant results of these studies, to data, is the overall broadeness of the optimum region of parameter space. Changes in the performance of one system can generally be compensated for by another system, resulting in a minimal change in the final COE. This paper discusses the tradeoffs leading to this conclusion and their implications relative to LIA design.

20424 **Repetition rates in heavy ion beam driven fusion reactors.** Peterson, R.R. (University of Wisconsin, Madison, WI 53706-1687). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 507-514(21 Jan 1986). (CONF-860510—).

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

The limits on the cavity gas density required for beam propagation and condensation times for material vaporized by target explosions can determine the maximum repetition rate of Heavy Ion Beam (HIB) driven fusion reactors. If the ions are ballistically focused onto the target, the cavity gas must have a density below roughly 10^{-4} torr (3×10^{12} cm^{-3}) at the time of propagation; other propagation schemes may allow densities as high as 1 torr or more. In some reactor designs, several kilograms of material may be vaporized off of the target chamber walls by the target generated x-rays, raising the average density in the cavity to 100 tor or more. A one-dimensional combined radiation hydrodynamics and vaporization and condensation computer code has been used to simulate the behavior of the vaporized material in the target chambers of HIB fusion reactors.

20425 **Economic studies for heavy-ion-fusion electric power plants.** Meier, W.R.; Hogan, W.J.; Bangerter, R.O. (Lawrence Liveremore National Laboratory, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 515-522(21 Jan 1986). (CONF-860510—).

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

We have conducted parametric economic studies for heavy-ion-fusion electric power plants. We examined the effects on the cost of electricity of several design parameters: cost and cost scaling for the reactor, driver, and target factory; maximum achievable chamber pulse rate; target gain; electric conversion efficiency; and net electric power. Using the most recent estimates for the heavy-ion-driver cost along with the Cascade reactor cost and efficiency, we found that a 1.5 to 3 GWe heavy-ion-fusion power plant, with a pulse rate of 5—10 Hz, can be competitive with nuclear and coal power plants.

20426 **Heavy-ion fusion reactor concepts, requirements, and attractive features.** Pendergrass, J.H. (Los Alamos National Laboratory, Los Alamos, NM 87545). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 531-538(21 Jan 1986). (CONF-860510—).

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

Four generic reactor-plant concepts were included in the Heavy Ion Fusion Systems Assessment to provide a wide range of pulse-repetition-rate/target-yield capability—1 to 20 Hz/150 to 3000 MJ. This permitted exploration of the impact on heavy-ion fusion cost o electricity (COE) of the repetition-rate and efficiency advantages of induction linacs relative to other ICF drivers. Minimum COE results are encouraging—from 55 to 75 mills/kWh for 1000-MWe plants to <45 mills/kWh for 1500 MWe. HIF with induction-linac drivers can compete using more than one reactor plant concept. Minimum COE corresponds to reactor repetition rates <10 Hz for 1000-MWe, one-reactor plants. Contrary to pre-HIFSA expectations, large pulse repetition rates are optimum only for very large plants. COE's are within 5% of minimum COE over wide ranges of repetition rate and target yield. Cost or technological problems in one part of plant parameter space need not be fatal for HIF because of the large low-COE parameter space.

20427 **Targets for laser and ion beam drivers.** Bangerter, R.O. (Lawrence Livermore National Laboratory, Livermore, CA 94550). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 547-552(21 Jan 1986). (CONF-860510—). Contract W-7405-ENG-48.

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

At the two previous heavy ion fusion symposia, researchers from Livermore presented their best estimates of target energy gain. The results presented at Tokyo differed significantly from those presented at Darmstadt. The Livermore estimates were again revised for this symposium. The new estimates are given in an accompanying paper by Lindl et al. and in additional detail in this paper. The new estimates are similar to the results presented at Darmstadt. The implications of the new results are discussed.

20428 **Present status and future prospects of light ions as drivers for inertial fusion.** VanDevender, J.P. (Sandia National Laboratories, Albuquerque, NM 87185). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 569-578(21 Jan 1986). (CONF-860510—). Contract AC04-76DP00789.

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

Light ion beams offer a low cost (50—80 $/J for repetitive driver), 20% efficient driver for Inertial Confinement Fusion (ICF).

20429 **Present status and future prospects of heavy ion beams as drivers for ICF.** Godlove, T.F. (U.S. Department of Energy, Office of Basic Energy Sciences, Washington, DC 20545). *AIP (American Institute of Physics) Conference Proceedings;* **152**: No. 1, 579-590(21 Jan 1986). (CONF-860510—).

From Symposium on heavy ion inertial fusion; Washington, DC, USA (27 May 1986).

A candidate driver for a practical inertial fusion reactor system must, among other characteristics, be cost effective and reliable for the parameters required by the fusion target and the remainder of the system. Although the history of large particle accelerators provides abundant evidence of their reliability at high repetition rates, their capital cost for the fusion application has been open to question. Attempts to design cost effective systems began with accelerators based on currently available technology such as RF linacs and storage rings. The West German HIBALL and the Japanese HIBLIC are examples of this initial effort. These designs are sufficiently credible that a strong argument can be made for the heavy ion method in general, but to reduce the cost per unit power it was found necessary to design for large scale, hence high capital cost. Emphasis in the U.S. shifted to newer technologies which offer hope of significant improvement in cost. In this paper the status of various heavy ion driver designs are compared with currently perceived requirements in order to illustrate their potential and assess their development needs.

20430 **ICF drivers: a comparison of some new entries with the old standbys.** Hogan, W.J. (Lawrence Livermore National Lab., CA). *Transactions of the American Nuclear Society;* **52**: 143(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

There has been a great deal of progress in recent years on the development of solid-state and KrF lasers, light ion diodes, and heavy ion accelerators for use as drivers in inertial confinement fusion (ICF) facilities. Sizable, ongoing programs exist at several laboratories for these driver concepts. Two new entries in the ICF driver derby are the free electron laser (FEL) and the compact torus (CT). In the FEL, a laser pulse of the appropriate frequency is amplified with very high efficiency by a high-current electron beam passing through a magnetic wiggler. In the CT driver, a small plasma torus with self-contained magnetic fields is created, compressed, accelerated, and directed at an ICF target. The result is potentially equivalent to a neutral, heavy-ion beam that has been accelerated in a very short distance. While both these technologies have been mentioned several times in the past, only recently have significant development programs been initiated to investigate them. In this paper, the new concepts will be described, the progress on

the older ones will be reviewed, and all will be compared to possible driver selection criteria for various applications.

20431 **Improved shielding calculations for the Particle Beam Fusion Accelerator II.** Sweeney, M.A.; Halbleib, J.A.; Tolk, K.M. (Sandia National Lab., Albuquerque, NM). *Transactions of the American Nuclear Society;* **52**: 143-144(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Even though PBFA-II accelerates ions, significant bremsstrahlung is produced from electron losses along the magnetically insulated transmission lines and in the diode. Shielding personnel and electronics from this intense bremsstrahlung was an important concern during the accelerator design phase. A previous study, using the three-dimensional Monte Carlo electron-photon transport code ACCEPT, indicated the need for additional close-in shielding and for relocation of some electronic control devices. New ACCEPT simulations, described here, include a more efficient version of the next-event-estimator calculation, a more realistic source distribution for the electrons, and recent design information for the diode and the top and bottom radiation shields.

20432 **Estimates of maximum trappable ion beam power in plasma channels.** Watrous, J.J.; Olson, R.E. (Univ. of Wisconsin, Madison). *Transactions of the American Nuclear Society;* **52**: 144-146(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Conservation laws and solutions to the equations of motion for single particles have been used to obtain greatest lower bounds on the ion beam power that can be injected into and confined within plasma channels. These bounds are of use in the evaluation of proposed light-ion-driven inertial confinement fusion (ICF) experiments and reactor concepts. Simple estimates of trappable power based on conservation laws will be compared with estimates based on solutions to the equations of motion. Consequences of the results of these calculations to current design studies will be discussed.

20433 **Conceptual design of a large electron-beam-pumped KrF laser for ICF commercial applications.** Harris, D.B.; Waganer, L.M.; Zuckerman, D.S.; Bowers, D.A. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **52**: 146-147(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

An attractive design for a commercial-application KrF laser-fusion driver has been developed. A key innovation is the linking of main amplifiers in groups of three, both optically and for gas handling. This reduces the cost and power consumption of the gas flow system, reduces the cost and complexity of the optical system, and results in a driver that is suitably efficient and affordable for an ICF electric power plant.

20434 **Conceptual design of a hybrid KrF laser system for ICF commercial applications.** Harris, D.B.; Lowenthal, D.D. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **52**: 147-149(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

KrF lasers appear to be the most efficient lasers operating near the optimal wavelength for laser fusion. Most high-efficiency, low-cost KrF laser designs use large electron-beam-driven amplifiers and use pure angular multiplexing for the required pulse compression. A recent study carried out by Los Alamos National Lab. and Spectra Technology has defied a high-efficiency hybrid KrF laser system architecture that uses both angular multiplexing and Raman beam combination. The high overall system efficiency of this hybrid design, ~ 12%, is achieved primarily through the use of electron-beam sustained discharge lasers (EBSDL), and by using the efficient forward rotational Raman process in hydrogen. The new system appears attractive as a commercial-applications driver because the calculated efficiency is higher than the usual large electron-beam-pumped (EBP) KrF laser/pure angular multiplexing approach. In this paper, the hybrid system architecture will be described, and the trade-offs with respect to the large EBP amplifier/angular multiplexed system will be discussed.

20435 **Compact torus accelerator as a driver for ICF.** Tobin, M.T.; Meier, W.R.; Morse, E.C. (Lawrence Livermore National Lab., CA). *Transactions of the American Nuclear Society;* **52**: 149-150(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The authors have carried out further investigations of the technical issues associated with using a compact torus (CT) accelerator as a driver for inertial confinement fusion (ICF). In a CT accelerator, a magnetically confined, torus-shaped plasma is compressed, accelerated, and focused by two concentric electrodes. After its initial formation, the torus shape is maintained for lifetimes exceeding 1 ms by inherent poloidal and toroidal currents. Hartman suggests acceleration and focusing of such a plasma ring will not cause dissolution within certain constraints. In this study, we evaluated a point design based on an available capacitor bank energy of 9.2 MJ. This accelerator, which was modeled by a zero-dimensional code, produces a xenon plasma ring with a 0.73-cm radius, a velocity of 4.14×10^9 cm/s, and a mass of 4.42 μg. The energy of the plasma ring as it leaves the accelerator is 3.8 MJ, or 41% of the capacitor bank energy. Our studies confirm the feasibility of producing a plasma ring with the characteristics required to induce fusion in an ICF target with a gain greater than 50. The low cost and high efficiency of the CT accelerator are particularly attractive. Uncertainties concerning propagation, accelerator lifetime, and power supply must be resolved to establish the viability of the accelerator as an ICF driver.

20436 **Characteristics of attractive commercial-application ICF reactors.** Pendergrass, J.H. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **52**: 170-171(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Many desirable characteristics, scientific and engineering principles, trade-offs, constraints, etc., are the same for ICF, MCF, and fission reactors. However, the two fission technologies also differ in substantive ways from each other and from fission, so that optimum solutions to similar problems for ICF, MCF, and fission can be significantly different. Our comparisons of ICF, MCF, and fission reactors will focus on unique characteristics of ICF that make a significant difference. Prominent among these are (a) the extreme pulsed nature of ICF energy release and the complexity of ICF fuel cycles that pose severe design and materials challenges and (b) relaxed vacuum requirements and partial separability of driver, fuel cycle, and reactor functions that may permit meeting the challenges.

20437 **Turbostar: an ICF reactor using both direct and thermal power conversion.** Pitts, J.H. (Lawrence Livermore National Lab., CA). *Transactions of the American Nuclear Society;* **52**: 172-173(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The Turbostar reactor concept efficiently converts fusion energy into kinetic energy, which is then directly converted to electricity using turbine generators. In this concept, a liquid-lithium (or lithium-lead) falling blanket is placed as close as possible to the central axis of the reactor. If looked at in cross section just before a fusion pulse, the blanket forms an annulus, unlike the cross section in the HYLIFE design (a previous inertial confinement fusion reactor concept), which forms a series of discrete jets. Turbostar is a novel concept because it retains the advantages of the HYLIFE and Sunburst designs while improving on their limitations. Turbostar is expected to have a 50% higher conversion efficiency than HYLIFE, and it does not require magnetic fields around the chamber, as the Sunburst reactor does.

20438 **Wetted foam capsules for direct drive ICF reactor application.** Darling, D.H.; Sacks, R.A. (Lawrence Livermore National Lab., CA). *Transactions of the American Nuclear Society;* **52**: 257-258(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The authors propose a new target approach that provides a passive mechanism for producing highly uniform spherically symmetric cryogenic D-T layers. This target employs a rigid foam matrix to support liquid (or solid) D-T in a spherical shell configuration. Capillary forces generated by the D-T wetting the foam matrix stabilize the liquid against gravitational flow. A schematic of the proposed wetted sponge reactor target is shown. In this design, a spherical sponge shell wetted with liquid D-T serves as ablator, tamper, and fuel layer. To serve as a capsule material, the foam must be open cell, have a high pore volume, and have sufficient mechanical strength. To minimize energy loss due to bremsstrahlung radiation during ignition and burn propagation, the foam in the fuel region should be both low density and low atomic number. One-dimensional LASNEX calculations predict that direct drive capsules composed of D-T-saturated plastic foam can achieve gains of 100 to 200 for incident laser energy at 200 to 700 kJ.

20439 Heavy-ion fusion target cost model. Pendergrass, J.H.; Harris, D.B.; Dudziak, D.J.; Billman, K.W. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **52**: 258-259(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

An improved HIF commercial-application target cost model has been developed through consultation with an ad hoc panel of experts as part of the HIFSA project. The same general principles and many specifics of the cost methodology are directly applicable to laser and light-ion fusion targets. The principal advantages of the new model include: (1) treatment of potentially significant differences in costs for a wide variety of distinctly different target concepts; (2) scaling of target costs with important ICF plant parameters such as driver pulse energy, repetition rate, and total fusion plant capacity; and (3) a generic formulation that can be conveniently interfaced with cost models for other fusion plant systems.

20440 Improved understanding of first-wall vaporization/recondensation in ICF reactors. Orth, C.D. (Lawrence Livermore National Lab., CA). *Transactions of the American Nuclear Society;* **52**: 259(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

In this paper, the results are presented of two studies that allow for improved understanding of the amount of material vaporized from and then recondensed on the first walls and/or blankets of low-pressure inertial confinement fusion (ICF) reaction chambers. One study, recently completed, has provided accurate spectra for the x rays and debris emanating from an ICF reactor target of current design. The other study, still ongoing, is an effort to improve computer modeling of the physical processes involved in the vaporization and recondensation of materials.

20441 High-gain test facility driven by a multimegajoule solid-state laser. Powell, H.T.; Manes, K.R.; Hogan, W.J. (Lawrence Livermore National Lab., CA). *Transactions of the American Nuclear Society;* **52**: 284-285(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

An ICF high-gain test facility (HGTF) will most certainly be in demand for other applications than ICF target physics. These will include advanced weapon physics, vulnerability and nuclear effects, and x-ray laser studies. These other applications will place additional demands on driver flexibility and will extend the desirable range of some of the driver variables (e.g., the desirable pulse length range would be 0.1 to 100 ns and the wavelength range would be 0.25 to 1.0 μm). It is also likely that to utilize the driver efficiently for the variety of applications foreseen will require multiple target chambers and experiment areas. Thus, it is important that the driver beams be efficiently transported to these different experimental areas. At the present time, the only driver capable of meeting this broad set of requirements is the Nd:glass laser. It has long been believed that an Nd:glass laser with the above requirements could be built but that it would be unreasonably expensive. There is still much work to be done. However, the progress to date and the track record for lowering system cost in past solid-state facilities, leads us to be optimistic that we can achieve our goal of building an affordable HGTF that will meet all the requirements.

20442 Comparison of the design and costs of induction linac drivers for inertial fusion using ions of differing mass. Hovingh, J.; Brady, V.O.; Faltens, A.; Lee, E.P. (Lawrence Livermore National Lab., NM). *Transactions of the American Nuclear Society;* **52**: 289-291(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

An induction linear accelerator that produces an energetic (5- to 20-GeV) beam of heavy (130- to 238-amu) ions is a prime candidate as a driver for inertial fusion. The required accelerator output parameters for an ion species can be determined from the target requirements for a given fusion energy yield. The cost and efficiency of various accelerator configurations to produce the required output parameters can be determined to aid in the selection of the lowest cost accelerator design option. In this study, we compare the cost of various accelerator configurations that will produce various target yields and fusion powers using ^{133}Cs ions with those using ^{200}Hg ions, and report extensively on some 600-MJ target yield results. It is concluded that very large cost reductions can be made on heavy-ion induction linac drivers for inertial fusion. These reductions are possible by increasing the charge state, increasing the undepressed tune, and optimizing the number of beamlets.

20443 Gain scaling relations for heavy-ion targets. Magelssen, G.R. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **52**: 291-292(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The author have developed scaling relationships that allow target gain to be calculated from the target hydrodynamic coupling efficiency, the target radius (r), and the ion energy absorbed by the target (E/sub ion/). We assume that the energy incident and energy absorbed are the same. As yet no experimental evidence suggests otherwise. These scaling relations were developed in a manner similar to that used by Meyer-ter-Vehn and by Bodner. The eta values, however, were determined from target calculations and analytical models of the target coupling physics and include symmetry constraints. The values of eta are given in graphical form that is curves of eta versus target radius for different values of the ion range. Scaling relationships have been developed for three single-shell target concepts. The target yield is the product of E/sub ion/ and G. From the target yield and the fuel burnup fraction, the fuel mass is determined. Also, the charged-particle and x-ray fraction of the yield D/sub xp/ can be estimated from the fuel rho r value.

20444 Targets for heavy-ion fusion. Bangerter, R.O. (Lawrence Livermore National Lab., CA). *Transactions of the American Nuclear Society;* **52**: 292(1986). (CONF-860610—).

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The paper gives a brief semiquantitative overview of the relationships between accelerator cost and target requirements. The fundamentals of target energetics, symmetry, and stability are discussed. This leads to a discussion of the range-energy relations for ion beams and motivate the interest in heavy ions for the commercial application of inertial fusion.

20445 Reactor designs for heavy-ion fusion. Pendergrass, J.H.; Meier, W.R. (Lawrence Livermore National Lab., CA). *Transactions of the American Nuclear Society;* **52**: 292-294(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The Heavy-Ion Fusion Systems Assessment (HIFSA) Project is a study of the prospects for successful pure fusion commercial HIF electric power generation using heavy-ion induction linear accelerator (linac) drivers. Although the project is led by Los Alamos National Lab. (LANL), success requires substantial contributions from all members of a large interdisciplinary team representing a unique assemblage of talent from other national lab-

oratories, universities, and industry. The four reactor concepts included in the HIFSA studies - CASCADE, HYLIFE, wetted-wall, and magnetically protected - can be coupled with heavy-ion induction linacs operating over a wide range of pulse repetition rates to permit thorough exploration of the potential advantages of induction linacs as drivers. These concepts incorporate several interesting options, including solid and liquid-metal blankets and first-wall protection concepts, conventional and advanced power generation cycles, etc. No substantive obstacles to adaptation of these laser fusion reactor concepts for HIF have yet been identified. In particular, the reactor/driver interfaces and achievement of the lower cavity atmosphere densities required for HIF and the reactor/driver interfaces do not present significant problems.

20446 **Heavy-ion beam transport in ICF reaction chambers.** Stroud, P. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **52**: 294-295(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

An analysis has been performed to determine the technological requirements for transporting a beam of heavy ions across an inertial confinement fusion (ICF) reaction chamber. This is a crucial issue because excessive beam expansion will reduce the driver energy deposited on the target and degrade the performance of the reactor system. The physical mechanisms that dominate beam expansion for heavy-ion fusion applications include emittance growth, instabilities, parallel momentum spread, and space charge. These mechanisms place technological constraints on such system parameters as beam voltage, beam power, number of beams, beam mass and charge state, final transport length, beam port radius, target radius, beam emittance, momentum tilt, and background chamber gas density. The economic analysis of a heavy-ion ICF reactor system requires a thorough understanding of the trade-offs among these parameters imposed by the beam expansion mechanisms.

20447 **Systems performance and cost model for heavy-ion fusion.** Zuckerman, D.S.; Driemeyer, D.E.; Waganer, L.M. *Transactions of the American Nuclear Society;* **52**: 295(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

As a part of the US Dept. of Energy-sponsored Heavy Ion Fusion Systems Assessment Project, a systems and costing computer model has been developed to examine the behavior of a linear induction accelerator-driven (linac) HIF power plant. The main purpose of this code is to examine different system and subsystem options as well as a large range of parameter space in which an HIF power plant might operate. The ultimate goals include the identification of: (a) desirable operating regimes, (b) preferred system and subsystem options, (c) systems with major cost impacts, and (d) systems where appropriate R & D or technological breakthroughs could yield significant economic benefits.

20448 **Heavy-ion fusion systems assessment: an overview.** Waganer, L.M.; Driemeyer, D.E.; Zuckerman, D.S.; Billman, K.W. *Transactions of the American Nuclear Society;* **52**: 296(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

A study is under way to evaluate the technical performance and economic attractiveness of linear induction-driven heavy-ion fusion (HIF) as an energy source for electrical power generation. This study is a cooperative effort of several national laboratories, universities, industrial contractors, and the Electric Power Research Institute under the leadership of Los Alamos National Lab. McDonnell Douglas Astronautics Company, assisted by Titan Systems, Inc., has the responsibility of integrating the cost and performance models of the driver, reactor, and balance-of-plant systems; evaluating different system options, and assessing the overall technical and economic performance of an HIF power plant. The design and performance of the individual system options have been developed by the other participants in the US Dept. of Energy-sponsored parent study and are provided for system integration and evaluation. This paper describes the integration and evaluation effort for the HIF Systems Assessment Project.

20449 **Heavy-ion fusion: future promise and future directions.** Dudziak, D.J.; Saylor, W.W.; Pendergrass, J.H. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **52**: 296-297(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The previous papers in this heavy-ion fusion special session have described work performed as part of the Heavy-Ion Fusion Systems Assessment (HIFSA) Project. Key technical issues in the design and costing of targets, induction linacs, beam transport, reactor, balance of plant, and systems integration have been identified and described. The HIFSA systems model was used to measure the relative value of improvements in physics understanding and technology developments in many different areas. Within the limits of our 1986 knowledge and imagination, this study defines the most attractive heavy-ion fusion (HIF) power plant concepts. The project has deliberately avoided narrowing the focus to a point facility design; thus, the generic systems modeling capability developed in the process allows for relative comparisons among design options. We will describe what are thought to be achievable breakthroughs and what the relative significance of the breakthroughs will be, although the specific mechanism for achieving some breakthroughs may not be clear at this point. This degree of optimism concerning such breakthroughs is probably at least as conservative as that used in other fusion assessments.

20450 **Trade-off study of liquid-metal self-cooled blankets.** Gohar, Y. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **52**: 298-299(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

A trade-off study of liquid-metal self-cooled blankets was carried out to define the performance of these blankets with respect to the main functions in a fusion reactor, and to determine the potential to operate at the maximum possible values of the performance parameters. The main purpose is to improve the reactor economics by maximizing the blanket energy multiplication factor, reduce the capital cost of the reactor, and satisfy the design requirements. The main parameters during the course of the study were the tritium breeding ratio (TBR), the blanket energy multiplication factor, the energy fraction lost to the shield, the ^{6}Li enrichment in the breeder material, the total blanket thickness, the reflector material selection, and the compositions of the different blanket zones. Also, the impact of different reactor design choices on the performance parameters was analyzed. The effect of the impurity control system (limiter or divertor), the material choice for the limiter, the elimination of tritium breeding from the inboard section of tokamak reactors, the coolant choice for the nonbreeding inboard blanket, and the neutron source distribution were part of the trade-off study. In addition, tritium breeding benchmark calculations were performed to study the impact of the use of different transport codes and nuclear data libraries. The importance and the negative effect of high TBR on the energy multiplication motivated the benchmark calculations.

20451 **SAFIRE: a systems analysis code for inertial fusion economics.** McCarville, T.J.; Carson, C.F.; Glasgow, B.B.; Meier, W.R. *Transactions of the American Nuclear Society;* **52**: 318-320(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The SAFIRE (Systems Analysis For ICF Reactor Economics) computer code has been developed to facilitate economic analyses of inertial confinement fusion (ICF) reactor concepts. The code is designed for parametric analyses of conceptual designs appearing in the literature, in particular HYLIFE, HIBALL, Cascade, EAGLE, and dry-wall concepts. The objective is to identify power plant parameters and configurations that provide economic advantages, thus guiding future design efforts.

20452 **(AERE-R—12293) Application of the Kramers-Kronig relations to the calculation of the dielectric loss tangent of high grade insulators.** Agnew, P.; Foreman, A.J.E. (UKAEA Atomic Energy Research Establishment, Harwell. Materials Development Div.). Dec 1986. 19p. H.M. Stationery Office, London, price Pound 4.00.

The use of high grade insulators in fusion reactors is discussed and the effects of radiation on their a.c. electrical properties is described. The equations describing radio frequency power loss are derived in terms of the complex relative permittivity, epsilonsub(r) = epsilon ′ -jepsilon ″. Epsilon ″ and epsilon ′ are shown to be related via the pair of integral transforms known as the Kramers-Kronig relations. The possibility of totally characterising a dielectric material by making only capacitance measurements is assessed. It is concluded that for high grade insulators, measurement of the real part of the permittivity cannot be made with sufficient precision in the radio frequency range (1MHz - 1GHz) to permit the radiation induced conductivity to be calculated in this way.

20453 **(CLM-R—264) Study of the prospects for development of low-activation martensitic stainless steels for first-wall and blanket structures in fusion reactors.** Tupholme, K.W.; Orr, J.; Dulieu, D.; Butterworth, G.J. (UKAEA Culham Lab., Abingdon). Apr 1986. 45p. H.M. Stationery Office, London, price Pound 5.00.

This study examines the potential of the elemental substitution approach to the design of low-activity martensitic stainless steels, subject to the requirement that the contact γ dose rate falls to a value that would allow essentially unrestricted handling of discarded material after a cooling period of 100 years. The factors governing the structure and properties of the 9-12%Cr martensitic steels are reviewed. Practicable substitutes for the proscribed elements molybdenum, nickel and niobium include tungsten, tantalum and an increased vanadium content in conjunction with optimised carbon, nitrogen and boron levels. Given the generally attractive combination of properties offered by the martensitic steels, the prospects for developing a satisfactory low-activity composition appear favourable. A series of experimental compositions and a programme of investigations are proposed to explore possible alloys with the objective of reproducing, as far as possible, the characteristics of existing fully martensitic high strength stainless steels.

20454 **(CLM-R—265) Investigation of the constitution, structure and properties of some low activation austenitic stainless steels proposed for fusion.** Bolt, A.H.; Pickering, F.B.; Butterworth, G.J. (UKAEA Culham Lab., Abingdon). Apr 1986. 33p. H.M. Stationery Office, London, price Pound 5.00.

An earlier study identified a number of possible high manganese, high nitrogen compositions as potential low-activation replacements for austenitic stainless steels of the types AISI 316, 320, 321 and FV548. In the present work, experimental casts of five proposed alloys were prepared and subjected to initial investigation of their microstructural constitution, phase stability and basic mechanical properties. With appropriate solution treatment it was possible to obtain fully austenitic constitutions for all the alloys. Precipitation hardening was most pronounced in the alloys having Ta:(C+N) ratios closest to stoichiometry for the relevant precipitate and, in the alloys with highest Ta contents, a Fe_2Ta Laves phase with needle-like morphology was observed to precipitate and subsequently spheroidise on prolonged ageing at 900°C. The steels showed high stability toward martensite transformation under deformation and refrigeration. Room temperature 0.2% proof stress values of 470-610 MPa and tensile strengths of 750-1000 MPa were obtained and a high tensile ductility was observed. The fatigue resistance was found to be similar to that of the analogous commercial steels but the creep rupture strength was lower than expected.

20455 **(CLM-R—273) Initial examinations of the weldability, creep properties, tempering response and grain size control in low-activation martensitic stainless steels.** Tupholme, K.W.; Dulieu, D.; Butterworth, G.J. (UKAEA Culham Lab., Abingdon). Mar 1987. 38p. H.M. Stationery Office, London, price Pound 5.00.

The welding characteristics, creep properties, additional mechanical properties and grain refinement techniques have been examined for low-activation martensitic stainless steels. Welding trials show that the LA7 alloy can be welded using TIG (tungsten-inert-gas) methods with preheat and post-weld stress relief heat treatment. Creep tests, which are still in progress, so far indicate that the steels LA7 and LA13 have higher creep strain rates and possibly lower rupture strengths than FV448 steel. An evaluations of the mechanical properties of some lower alloy content low-activation steels indicate that the steels possess lower strength coupled with an enhanced toughness. It has been demonstrated that grain refinement can be accomplished by means of tantalum additions, and there are strong indications that the soluble nitrogen content influences the delta ferrite content.

20456 **(CONF-871007—82) Capacitor analysis for rf antennas.** Power, W.H.; Baity, F.W.; Hoffman, D.J. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 4p. NTIS, PC A02. Order Number DE88004178/JAW.

From 12. symposium on fusion engineering; Monterey, CA, USA (12 Oct 1987).

Commercially available vacuum capacitors have been used in radio frequency (rf) antenna designs. The dimensional envelope of the capacitors has adapted favorably to antenna concepts. However, capacitors that are commercially available have not demonstrated acceptable performance characteristics for maximum design currents of 800 A rms at 80 MHz and 1300 A rms at 30 MHz or for voltages of 50 kV peak. The reason for capacitor failure was investigated. The investigation consisted of establishing existing mechanical design features, defining desired operating criteria of key capacitor components, determining component design limitations, and developing a modified concept for testing. The design criteria included a variable capacitance range of 50 to 450 pF at the maximum current conditions. Effects of capacitor cooling by means of radiative transfer and forced convective transfer were considered. The resulting modified capacitor design concept uses as many components of the commercially available capacitors as possible. An apparatus for testing and evaluation was designed for the proposed capacitor concepts. Tests have demonstrated reliable operations at 750 A and 80 MHz cw on a similar design. 2 refs., 5 figs.

20457 **(DOE/ER—0313/1) Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.** (Oak Ridge National Lab., TN (USA)). Sep 1987. Contract AC05-84OR21400. 424p. NTIS, PC A18/MF A01; 1; GPO Dep. Order Number DE88003657/JAW.

These activities are concerned principally with the effects of the neutronic and chemical environment on the properties and performance of reactor materials; together they form one element of the overall materials program being conducted in support of the Magnetic Fusion Energy Program of the US Department of Energy. The major areas of concern covered in this report are irradiation facilities, test matrices, and experimental methods; dosimetry, damage parameters and activation calculations; materials engineering and design requirements; radiation effects; development of structural alloys; solid breeding materials; ceramics and superconducting magnet materials. There are 61 reports cataloged separately. (LSP)

20458 (DOE/ER—0313/1, pp 5-6) **Design of the HFIR [High Flux Isotope Reactor] spectral tailoring experiments in the HFIR RB* capsule irradiation facility.** Longest, A.W.; Corum, J.E.; Thoms, K.R. (Oak Ridge National Lab., TN; Midwest Technical, Inc., Oak Ridge, TN). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this work is to design and build irradiation capsules for use in the HFIR RB* positions. Japanese and US specimens are to be transferred to RB* positions following irradiation to ~5 dpa at temperatures of 60, 200, 330, and 400°C in ORR experiments ORR-MFE-6J and -7J.

20459 (DOE/ER—0313/1, pp 7-12) **Design and operation of the HFIR [High Flux Isotope Reactor] instrumented (JP type) target temperature test (TTT) capsule.** Siman-Tov, I.I. Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The primary objective of this experiment is to determine the temperatures in the JP series capsules by placing an instrumented JP mockup experiment in the modified HFIR instrumented target facility. A secondary objective is to determine the nuclear heating rate in stainless steel as a function of axial core position and time in a HFIR cycle. 5 refs., 5 figs., 1 tab.

20460 (DOE/ER—0313/1, pp 13-17) **Characterization of the NLTNIF [National Low-Temperature Neutron Irradiation Facility] facility in the BSR [Bulk Shielding Reactor].** Greenwood, L.R. (Argonne National Lab., IL). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this work is to characterize neutron irradiation facilities in terms of neutron fluence and spectra as well as displacement damage, gas production, and other transmutation. 3 figs., 4 tabs.

20461 (DOE/ER—0313/1, pp 30-31) **Fusion program research materials inventory.** Roche, T.K.; Davis, J.W. (Oak Ridge National Lab., TN; McDonnell Douglas Astronautics Co., St. Louis, MO). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

Oak Ridge National Laboratory maintains a central inventory of research materials to provide a common supply of materials for the Fusion Reactor Materials program. This minimizes unintended material variations and provides for economy in procurement and for centralized record-keeping. Initially, this inventory is to focus on materials related to first-wall and structural applications and related research, but various special-purpose materials may be added in the future. The use of materials from this inventory that is coordinated with or otherwise related technically to the Fusion Reactor Materials program of the Department of Energy is encouraged. 2 tabs.

20462 (DOE/ER—0313/1, pp 32-34) **Irradiation of Fe-Cr-Ni austenitic alloys at 400 to 750°C in the MOTA-1E experiment.** Garner, F.A. (Westinghouse Hanford Co., Richland, WA). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The object of this effort is to provide irradiated specimens for the exploration of the compositional dependence of microstructural evolution, particularly that of the spinodal-like decomposition and various order-disorder transformations observed after irradiation of austenitic Fe-Ni-Cr alloys with high nickel levels. 5 refs., 2 tabs.

20463 (DOE/ER—0313/1, pp 37) **Production of long-lived activities in fusion reactors.** Greenwood, L.R.; Bowers, D.L. (Argonne National Lab., IL). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

This research seeks to measure 14 MeV neutron production rates of long-lived isotopes in fusion materials for waste disposal, maintenance, and dosimetry applications. 4 refs.

20464 (DOE/ER—0313/1, pp 41) **International dosimetry standardization activities.** Greenwood, L.R. (Argonne National Lab., IL). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The aim of this research is to standardize neutron dosimetry measurements and radiation damage calculations to facilitate the comparison of materials effects under irradiation. 2 refs.

20465 (DOE/ER—0313/1, pp 42-43) **Helium production cross sections for fusion-energy neutrons.** Kneff, D.W.; Skowronski, R.P.; Oliver, B.M. (Rockwell International, Canoga Park, CA). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this work is to measure the total helium production cross sections of materials for fusion-energy neutrons. 4 refs.

20466 (DOE/ER—0313/1, pp 73-74) **REAC2 activation and transmutation computer code system.** Mann, F.M. (Westinghouse Hanford Co., Richland, WA). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this work is to develop a computer code system which can quickly and easily calculate the transmutation and activation of materials in nuclear environments. 2 refs.

20467 (DOE/ER—0313/1, pp 87-107) **Mechanical properties of fusion reactor materials.** Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

This paper discusses topics on the mechanical properties of fusion reactor materials. The particular topics covered are: flow processes, time dependent crack growth, time independent crack growth/brittle fracture and environment assisted crack growth. 22 refs., 5 figs. (LSP)

20468 (DOE/ER—0313/1, pp 108-126) **Effect of internal hydrogen on the fatigue crack growth of HT-9.** Rodkey, G.F.; Jones, R.H. (Pacific Northwest Lab., Richland, WA). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

A previous evaluation indicated that under certain circumstances hydrogen could cause subcritical crack growth of HT-9 in a fusion reactor environment. This previous evaluation only examined static load conditions and it was noted that there is a lack of data on hydrogen effects on fatigue crack growth of HT-9; however, the fatigue crack growth properties of steels are sensitive to hydrogen. Therefore, the objective of this study was to determine the effects of hydrogen on the fatigue crack growth of HT-9 and to develop a data base which could be used for modeling these effects. 14 refs., 16 figs., 5 tabs.

20469 (DOE/ER—0313/1, pp 129-139) **Microstructure of copper alloys following 14-MeV neutron irradiation.** Zinkle, S.J. Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this study is to gain a better understanding of the evolution of the microstructure of fcc metals during 14-MeV neutron irradiation. Results from this study may be utilized to develop fission/fusion neutron correlations and to guide the development of theoretical models of the damage process. 52 refs., 11 figs., 1 tab.

20470 (DOE/ER—0313/1, pp 140-144) **OWR/RTNS-II Low Exposure Spectral Effects Experiment: Effects of irradiation temperature.** Heinisch, H.L. (Westinhgouse Hanford Co., Richland, WA). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this experiment is to determine the effect of the neutron spectrum on radiation-induced changes in mechanical properties for metals irradiated with fusion and fission neutrons. 4 refs., 3 figs., 1 tab.

20471 (DOE/ER—0313/1, pp 145-149) **The effects of low doses of 14 MeV neutrons on the tensile properties of three binary copper alloys.** Heinisch, H.L.; Pintler, J.S. (Westinghouse Hanford Co., Richland, WA). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this experiment is to determine the effect of 14 MeV neutrons on radiation-induced changes in mechanical properties of three alloys of copper, Cu5%Al, Cu5%Mn and Cu5%Ni, and to compare the effects of 14 MeV and fission reactor neutrons. 4 refs., 4 figs., 1 tab.

20472 (DOE/ER—0313/1, pp 150-160) **Effects of substitutional alloying elements on microstructural evolution in neutron irradiated Fe-10Cr.** Gelles, D.S. (Westinghouse Hanford Co., Richland, WA). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this effort is to determine the effects of substitutional alloying elements in an Fe-10Cr base composition on microstructural development due to neutron irradiation. The alloying elements selected are of interest in reduced activation applications and include a wide range of atom sizes. 11 refs., 10 figs., 3 tabs.

20473 (DOE/ER—0313/1, pp 161-165) **Swelling of solute-modified Fe-Cr-Mn alloys in FFTF [Fast Flux Test Facility].** Garner, F.A. (Westinghouse Hanford Co., Richland, WA). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The object of this effort is to assess the suitability of austenitic Fe-Cr-Mn alloys as low activation candidates for fusion reactor structural materials. 6 refs., 5 figs., 3 tabs.

20474 (DOE/ER—0313/1, pp 166-176) **Cessation of irradiation creep in AISI 316 concurrent with high levels of swelling.** Porter, D.L.; Garner, F.A. (Argonne National Lab., Idaho Falls, ID; Westinghouse Hanford Co., Richland, WA). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The object of this effort is to study the relationship between radiation-induced microstructural alterations in metals and the associated macroscopic consequences of swelling, creep, mechanical properties and fracture modes. 18 refs., 8 figs.

20475 (DOE/ER—0313/1, pp 177-181) **Analysis of high dose swelling data from the RS-1 experiment.** Stoller, R.E. Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this work is to compile and analyze the available swelling data base for austenitic stainless steels to help provide direction for alloy development and support for theoretical modeling efforts. 15 refs., 3 figs., 1 tab.

20476 (DOE/ER—0313/1, pp 182-194) **Spinodal-like decomposition of Fe-Ni and Fe-Ni-Cr invar alloys in both radiation and non-radiation environments.** Garner, F.A.; McCarthy, J.M.; Dodd, R.A.; Russell, K.C. (Westinghouse Hanford Co., Richland, WA; Univ. of Wisconsin, Madison; Massachusetts Institute of Technology, Cambridge). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objectives of this effort are to determine the mechanisms by which alloys evolve during irradiation and to use this information to develop a low swelling austenitic alloy in the invar compositional range. 20 refs., 12 figs.

20477 (DOE/ER—0313/1, pp 195-209) **Effect of nickel content on the minimum critical radius of Fe-Cr-Ni alloys.** Coghlan, W.A.; Garner, F.A. (Arizona State Univ., Tempe; Westinghouse Hanford Co., Richland, WA). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The object of this effort is to determine the mechanisms by which materials evolve under irradiation and to predict the changes that will occur in fusion neutron environments. 30 refs., 12 figs., 2 tabs.

20478 (DOE/ER—0313/1, pp 210-218) **The influence of phosphorus on the neutron or ion-induced swelling of Fe-Cr-Ni alloys.** Garner, F.A. (Westinghouse Hanford Co., Richland, WA). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The object of this effort is to determine the effect of phosphorus on radiation-induced swelling, creep and microstructural development and explore the interaction of phosphorus with other important factors such as the displacement rate, the helium/dpa ratio, the concentration of other minor solute elements and the identity of the damage-producing particle. 34 refs., 4 figs., 2 tabs.

20479 (DOE/ER—0313/1, pp 219-229) **The swelling of nickel and nickel-chromium alloys during neutron or ion irradiation.** Garner, F.A. (Westinghouse Hanford Co., Richland, WA). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The object of this effort is to determine those factors which control the swelling, creep and mechanical properties of irradiated metals.

20480 (DOE/ER—0313/1, pp 230-238) **TEM cross-section observation of gas effect on void formation in ion irradiated nickel.** Wang, L.M.; Dodd, R.A.; Kulcinski, G.L. (Univ. of Wisconsin, Madison). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The object of this study is to better understand the role of helium and oxygen atoms in void nucleation and growth in irradiated materials. 18 refs., 9 figs.

20481 (DOE/ER—0313/1, pp 239-245) **The effect of oxygen on void stability in nickel.** Seitzman, L.E.; Wang, L.M.; Kulcinski, G.L.; Dodd, R.A. (Univ. of Wisconsin, Madison). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The object of this study is to calculate the minimum oxygen concentration capable of stabilizing voids in irradiated nickel. 30 refs., 3 figs., 2 tabs.

20482 (DOE/ER—0313/1, pp 251-261) **Radiation embrittlement of manganese-stabilized martensitic stainless steel.** Gelles, D.S.; Hu, W.L. (Westinghouse Hanford Co., Richland, WA). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The object of this work is to evaluate the irradiation embrittlement behavior of manganese stabilized martensitic stainless steels in support of low activation ferritic alloy design. 4 refs., 14 figs.

20483 (DOE/ER—0313/1, pp 265-274) **Tensile properties of HFIR-irradiated austenitic stainless steels at 250 to 400°C from the European Community/US/Japan fusion materials collaboration.** Grossbeck, M.L. Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

Austenitic steels are being irradiated in different experimental reactors to achieve a variation in He:dpa ratio. Mechanical properties at temperatures relevant to INTOR are being determined; in the present report, only tensile property results are presented. Four alloys were selected for study: European Community (EC); type 316 stainless steel (EC316); US type 316 stainless steel (US316); Japanese PCA (JPCA); and USPCA. All four alloys are being irradiated in the HFIR at Oak Ridge, the HFR at Petten, the BR-2 at Mol, Belgium, and the R2 at Studsvik, Sweden. Furthermore, the US alloys are being irradiated in the ORR at Oak Ridge. The present report details the tensile property experiment using the HFIR. 4 refs., 11 figs., 4 tabs.

20484 (DOE/ER—0313/1, pp 275-279) **Irradiation-enhanced precipitates in type 316 stainless steel irradiated in HFIR [High Flux Isotope Reactor].** Hamada, S.; Tanaka, M.P.; Maziasz, P.J. Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this work is to determine the precipitation behavior of Japanese type 316 stainless steel during irradiation in the HFIR. 7 refs., 5 figs., 1 tab.

20485 (DOE/ER—0313/1, pp 280-285) **Temperature dependence of swelling in type 316 stainless steel irradiated to about 33 dpa in HFIR [High Flux Isotope Reactor].** Hamada, S.; Tanaka, M.P.; Maziasz, P.J. Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this research is to obtain fundamental data on swelling in a Japanese heat of type 316 stainless steel irradiated in HFIR at 300 to 600°C and to evaluate heat-to-heat variations in behavior by comparison with US heats of type 316 stainless steel. 8 refs., 3 figs., 1 tab.

20486 (DOE/ER—0313/1, pp 286-290) **The development of austenitic stainless steels for fast induced-radioactivity decay.** Klueh, R.L.; Maziasz, P.J. Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

During the operation of a fusion reactor, the structural material of the first-wall and blanket structure will become highly radioactive from activation by the fusion neutrons. Disposal of this material after the service lifetime will be a difficult radioactive waste-management problem. One way to minimize the disposal problem is to use structural materials in which radioactive isotopes induced by irradiation rapidly decay to levels that allow simplified disposal techniques. We are assessing the feasibility of developing such austenitic stainless steels. 4 refs., 2 figs., 4 tabs.

20487 (DOE/ER—0313/1, pp 293-296) **Preparation and fabrication of vanadium base alloys.** Thresh, H.R.; Hins, A.G. (Argonne National Lab., IL). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this task is twofold: to provide an inventory of vanadium alloy sheet material for testing in other parts of the development program and to investigate the importance of process variables on the properties of the candidate vanadium alloys. This objective provides for the establishing of a materials processing flowstream that is capable of synthesizing vanadium base alloys and fabricating cast alloys to a final flat stock form. Initial efforts are focused on the V-Cr-Ti alloy system, with priority being given to the V-15Cr-5Ti alloy. Other alloys selected for development include V-10Cr-5Ti and V-10Cr-10Ti. 1 ref., 3 figs., 1 tab.

20488 (DOE/ER—0313/1, pp 297-301) **Development of a vanadium-base alloy structural material.** Loomis, B.A. (Argonne National Lab., IL). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this research is to determine the composition of a vanadium-base alloy with the optimum combination of swelling resistance, corrosion resistance, and mechanical properties in the environment of a magnetic fusion reactor. 9 refs., 1 fig., 1 tab.

20489 (DOE/ER—0313/1, pp 302-307) **Effect of preinjected helium on the response of V-20Ti pressurized tubes to neutron irradiation.** Vitek, J.M.; Braski, D.N.; Horak, J.A. Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The goal of this experiment was to investigate the combined effects of displacement damage and helium generation on the behavior of pressurized vanadium alloy tubes. 13 refs., 6 figs., 1 tab.

20490 (DOE/ER—0313/1, pp 311-320) **Effects of neutron irradiation to 63 dpa on the properties of various commercial copper alloys.** Brager, H.R. (Westinghouse Hanford Co., Richland, WA). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this effort is to determine the effect of high neutron fluence on the properties of high purity copper and of a range of conventional commercial high-conductivity, high-strength, copper-base alloys. 6 refs., 9 figs., 1 tab.

20491 (DOE/ER—0313/1, pp 321-322) **Neutron irradiation of copper alloys: Phase 2.** Brager, H.R. (Westinghouse Hanford Co., Richland, WA). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

By using fast reactor irradiated copper alloy data, the author investigates the effects of neutron irradiation on the properties of high-conductivity, high-strength, irradiation-resistant copper base alloys for use in the design of MFE systems. 3 refs., 1 tab.

20492 (DOE/ER—0313/1, pp 325-330) **Environmental and chemical effects on the properties of vanadium-base alloys.** Diercks, D.R.; Smith, D.L. (Argonne National Lab., IL). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this task is to experimentally evaluate the corrosion behavior of selected vanadium-base alloys in aqueous, liquid-metal, and gaseous environments and to investigate chemical effects on the mechanical and physical properties of the alloys. The results of these investigations will be used in the selection of appropriate vanadium-base alloys for structural applications in fusion reactors. 7 refs., 5 figs., 1 tab.

20493 (DOE/ER—0313/1, pp 331-336) **Corrosion studies in thermally convective lithium: 12Cr-1MoVW steel and low activation austenitic and ferritic alloys.** Tortorelli, P.F. Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The purpose of this task is to determine the corrosion resistance of candidate first-wall materials to slowly flowing lithium in the presence of a temperature gradient. Corrosion and deposition rates are measured as functions of time, temperature, additions to the lithium, and flow conditions. These measurements are combined with chemical and metallographic examinations of specimen sur-

faces to establish the mechanisms and rate-controlling processes for dissolution and deposition reactions. 6 refs., 5 figs., 3 tabs.

20494 (DOE/ER—0313/1, pp 337-342) **Long-term corrosion of type 316 stainless and 12Cr-1MoVW steels in thermally convective Pb-17 at. % Li.** Tortorelli, P.F. Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The purpose of this work is to determine the corrosion resistance of candidate first-wall materials to slowly flowing Pb-17 at. % Li in the presence of a temperature gradient. Dissolution and deposition rates are measured as functions of time, temperature, and additions of minor elements to the lead-lithium. These measurements are combined with chemical and metallographic examinations of specimen surfaces to establish the mechanisms and rate-controlling processes for the dissolution and deposition reactions. 5 refs., 5 figs., 1 tab.

20495 (DOE/ER—0313/1, pp 343-348) **Corrosion of ferritic steels and V-15Cr-5Ti alloy in flowing lithium.** Chopra, O.K.; Smith, D.L. (Argonne National Lab., IL). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this program is to investigate the influence of a flowing lithium environment on the corrosion behavior and mechanical properties of structural alloys under conditions of interest for fusion reactors. Corrosion rates are determined by measuring the weight change and depth of internal corrosive penetration as a function of time and temperature. These measurements, coupled with metallographic evaluation of the alloy surface, are used to establish the mechanism and rate-controlling process for the corrosion reactions. Initial effort on mechanical properties is focused on fatigue and tensile tests in a flowing lithium environment of controlled purity. 9 refs., 5 figs., 3 tabs.

20496 (DOE/ER—0313/1, pp 349-352) **Corrosion of ferrous alloys in flowing Pb-17Li environment.** Chopra, O.K.; Smith, D.L. (Argonne National Lab., IL). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The objective of this program is to investigate the influence of a flowing Pb-17 at. % Li environment on the corrosion behavior and mechanical properties of structural alloys under conditions of interest for fusion reactors. Corrosion behavior is evaluated by measuring the weight change and depth of internal corrosive penetration of alloy specimens exposed to flowing Pb-17Li for various times. The dissolution rates are determined as a function of temperature. Metallographic examination of the alloy surface is used to establish the mechanism and rate-controlling process for the corrosion reactions. Initial effort on mechanical properties is focused on tensile tests in a flowing Pb-17Li environment. 10 refs., 3 figs., 1 tab.

20497 (DOE/ER—0313/1, pp 401-405) **In-waveguide measurements of MMW [millimeter-wave] dielectric properties of candidate fusion ceramics.** Frost. H.M.; Kise, C.D. (Los Alamos National Lab., NM). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

To measure dielectric constants "k" and loss tangents "tanδ" at room temperature and millimeter-wave (MMW) frequencies of ceramics within waveguide for their screening as rf-window materials, and to increase the corresponding precision and accuracy for this difficult measurement technique. 11 refs., 2 figs., 1 tab.

20498 (DOE/ER—0313/1, pp 406-407) **Properties and radiation resistance of the candidate rf window materials SiC and Al_2O_3.** Frost, H.M.; Clinard, F.W. Jr.; Iwamoto, N. (Los Alamos National Lab., NM; Osaka Univ., Japan). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The goal of this work is to assess changes in dielectric loss and other properties of Hitaceram SC-101 SiC and AD-995 Al_2O_3 before and after irradiation with 14 MeV neutrons in RTNS-II, as part of a study of candidate ceramics for rf window and related applications. 8 refs.

20499 (DOE/ER—0313/1, pp 408-416) **On neutron-induced damage to the millimeter-wave dielectric properties of alumina.** Frost, H.M.; Lawson, A.C.; Zocco, T.G.; Hobbs, L.W. (Los Alamos National Lab., NM; Massachusetts Institute of Technology, Cambridge). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

Concerning the polycrystalline 99.5% alumina previously found to undergo a doubling of dielectric loss factor at 90 to 100GHz via fast-neutron irradiation, to correlate our prior and current results with the dielectric and neutronic literature on alumina, and identify possible mechanisms for the damage. 31 refs., 3 figs., 2 tabs.

20500 (DOE/ER—0313/1, pp 419-425) **Irradiation effects on organic insulators.** Kasen, M.B. (National Bureau of Standards, Boulder, CO). Sep 1987. NTIS, PC A18/MF A01. Order Number DE88003657/JAW.

In Fusion reactor materials: Semiannual progress report for period ending September 30, 1986.

The overall objective of this work is to develop functional organic-matrix composite insulators for use in the superconducting magnets of magnetic fusion energy systems. The immediate objective is to develop a method for efficient screening of the significant parameters influencing degradation of such materials under neutron irradiation at 4°K. 4 refs., 7 figs., 1 tab.

20501 (ENEA-RT-FUS—86-7, pp 41-46) **Surface conditioning technique in the FTU vacuum chamber.** Apicella, M.L.; Daclon, F.; Alessandrini, C. (ENEA, Frascati, Italy. Centro Ricerche Energia). 1987. NTIS (US Sales Only), PC A06. Order Number DE87752631/JAW. (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

The FTU vacuum wall is completely covered by thermal shields. In this work are described and discussed the wall conditioning techniques performed on 1:1 scale toroidal sector to assure the ultimate pressure foreseen (<2.6 * 10/sup -6/ Pa). An ultimate pressure of 6.2 * 10/sup -7/ Pa has been obtained after baking at 190 degrees centigrade. An improvement of a factor 8 in the ultimate pressure has been obtained by using glow discharge in H/sub 2/ for five hours at 100 grade centigrade. Influence of the geometry of the vacuum vessel has been discussed.

20502 (ENEA-RT-FUS—86-7, pp 53-58) **Development status of FTU control.** Berardi, B.; Fermani, G.; Bombi, F. (ENEA, Frascati, Italy. Centro Ricerche Energia; Padua Univ., Italy. Ist. di Elettrotecnica e di Elettronica). 1987. NTIS (US Sales Only), PC A06. Order Number DE87752631/JAW. (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

The system uses 4 minicomputers acting as plant control unit (PCU) connected via Ethernet to a supervisory control unit (SCU). Subplant control is provided by programmable logic controller (PLC) and a unit called fast sequence (FSC) is used during pulse sequence. Finally the FDA unit performs fast data acqusitions.

20503 (ENEA-RT-FUS—86-7, pp 79-85) **Magnetic phase induced by plasma disruption in AISI 316 SS.** Brossa, F.; Rigon, G.; Moretto, G.; Franconi, E. (Commission of the European Communities, Ispra, Italy. Joint Research Centre; Politecnico di Torino, Italy; ENEA, Frascati, Italy. Centro Ricerche Energia). 1987. NTIS (US Sales Only), PC A06. Order Number DE87752631/JAW. (CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

One of the advantages of austenitic stainless steels is that they are non-magnetic, and so do not interact with the strong magnetic fields present in the tokamak. Despite this, some mushroom elements subject to several hard disruptions in the FT tokamak show a ferromagnetic phase in the melted and recrystallized zone. The stainless steel droplets coming from the limiter also show strong ferromagnetic behaviour. The aim of this work is to investigate the causes that have produced this magnetic phase in the material. For this purpose, the melted zones of the mushroom elements and the quickly-solidified droplets collected on the inner wall of FT were characterized in terms of magnetic permeability, chemical and structural modifications, and the results were compared with samples prepared in the laboratory.

20504 **(EUR—10337) EURAC: the JRC proposal for an European fusion reactor materials test and development facility.** Kley, W.; Bishop, G.R. (Commission of the European Communities, Ispra (Italy). Joint Research Centre; Commission of the European Communities, Luxembourg). 1986. 37p. (CONF-850762—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751579/JAW.

From 8. meeting of international collaboration on advanced neutron sources; Oxford, UK (7 Jul 1985).

For the last 7 years we examined the use of a Spallation Neutron Source (SNS) as an altenative European Option to FMIT. For an optimized spallation neutron source design we find now for the same beam power the following design parameters: - Linear Accelerator: 600 MeV, 6 m-A-proton beam on liquid lead target - irradiation parameters: 320 dpa/year in 20 cm/sup 3/ or 274 dpa/year in 31.5 cm/sup 3/ $6 <$ He appm/dpa $\leqq 13$. The present conceptual spallation neutron source target would allow us to use a 1200 MeV, 24 mA-proton beam, if required. The Ispra SNS-Target Station will be designed for these parameters. For synergetic experiments concerning fatigue and radiation damage the continuous proton beam will be periodically deflected on the target. $\Delta t = 9$ sec. $f = 10$/sup -1/ sec/sup -1/ in order to simulate the Pulsed Mode of Tokamak Power Reactors. The deflected beam can be used for other experiments.

20505 **(IAE—4348/7) Investigation of a limiter scrape-off layer and its screening effect on LIBTOR tokamak.** Leonov, V.M.; Malakhov, N.P.; Alabyad, A.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1986. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700854/JAW.

The main purpose of this work is to investigate screening properties of the limiter scrape-off layer (LSL), define the optimum width of this layer and investigate how energy and particle fluxes transfer from plasma to surrounding material surfaces from in the Libtor tokamak. For this, two moving rail molybdenum limiters (large as a working limiter and small as a probe), equipped with shunts and thermocouples were placed on the bottom side of tokamak at 980 deg apart the torus. The main results of the work are as follows: the introduction of a limiter allows an essential shielding of the chamber wall from the interaction with plasma and a reduction in the impurity influx into the plasma column. The main mechanism of the limiter erosion in the stationary part of a discharge is the ion sputtering. An active control over the limiter sputtering, over the heat and particle fluxes onto the limiter and over the plasma confinement time can be found to be of importance for the prospects of the limiter application as an alternative to the divertor in the tokamak-reactor. 6 refs.; 4 figs.

20506 (ORNL—6332, pp 317-339) **Materials research and development.** Oct 1987. NTIS, PC A19/MF A01. Order Number DE88003651/JAW.

In Fusion Energy Division annual progress report period ending December 31, 1986.

Development of austenitic stainless steels is carried out in collaboration with Japan. Spectral tailoring experiments in the Experimental Breeder Reactor-II (EDB-II) and the High-Flux Isotope Reactor (HFIR) explore the irradiation responses of these steels under conditions expected in near-term reactors. Exploratory research - including basic physical metallurgical studies, Fast-Flux Test Facility (FFTF) and dual-ion irradiations, and liquid-metal coolant compatibility studies - has continued on manganese-stabilized austenitic stainless steels, which are possible low-activation structural alloys. Research on ferritic steels involves investigation of ductile-to-brittle transitions, high-temperature strength, corrosion properties, and radiation response. In studies of radiation effects in vanadium alloys, fusion-relevant helium levels are introduced, and subsequent irradiation in the FFTF or EBR-II creates displacement damage. Four vanadium alloys were studied during 1986; they are, in general, more resistant to swelling than either the austenitic or the ferritic steels. Changes in strength and elastic modulus following irradiation were studied in copper and copper alloys. Radiation-enhanced recrystallization was observed in two high-strength copper alloys. The electrical resistivity, Vickers microhardness, and damage microstructure of pure copper and copper alloys were examined as functions of neutron fluence. Radiation damage mechanisms were considered in evaluations of the prospects for reduced-activation alloys. In the special-purpose materials area, a program was initiated in which isotopically tailored ceramics are irradiated in mixed-spectrum reactors to create the helium, hydrogen, and displacement damage levels appropriate to the fusion environment.

20507 **(ORNL—6430) Microstructural evolution in fast-neutron-irradiated austenitic stainless steels.** Stoller, R.E. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 376p. NTIS, PC A17/MF A01; 1; GPO Dep. Order Number DE88006045/JAW.

The present work has focused on the specific problem of fast-neutron-induced radiation damage to austenitic stainless steels. These steels are used as structural materials in current fast fission reactors and are proposed for use in future fusion reactors. Two primary components of the radiation damage are atomic displacements (in units of displacements per atom, or dpa) and the generation of helium by nuclear transmutation reactions. The radiation environment can be characterized by the ratio of helium to displacement production, the so-called He/dpa ratio. Radiation damage is evidenced microscopically by a complex microstructural evolution and macroscopically by density changes and altered mechanical properties. The purpose of this work was to provide additional understanding about mechanisms that determine microstructural evolution in current fast reactor environments and to identify the sensitivity of this evolution to changes in the He/dpa ratio. This latter sensitivity is of interest because the He/dpa ratio in a fusion reactor first wall will be about 30 times that in fast reactor fuel cladding. The approach followed in the present work was to use a combination of theoretical and experimental analysis. The experimental component of the work primarily involved the examination by transmission electron microscopy of specimens of a model austenitic alloy that had been irradiated in the Oak Ridge Research Reactor. A major aspect of the theoretical work was the development of a comprehensive model of microstructural evolution. This included explicit models for the evolution of the major extended defects observed in neutron irradiated steels: cavities, Frank faulted loops and the dislocation network. 340 refs., 95 figs., 18 tabs.

20508 **(PNL-SA—15185) Influence of neutron irradiation on the Charpy impact properties of V-15Cr-5Ti.** Cannon, N.S.; Hamilton, M.L.; Ermi, A.M.; Gelles, D.S.; Hu, W.L. (Pacific Northwest Lab., Richland, WA (USA); Hanford Engineering Development Lab., Richland, WA (USA)). Aug 1987. Contract AC06-76RL01830. 17p. (CONF-871036—30). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003430/JAW.

From 3. international conference on fusion reactor materials; Karlsruhe, F.R. Germany (4 Oct 1987).

Vanadium alloys are being evaluated for fusion reactor first wall and blanket applications to achieve both low neutron activation and operating temperatures above those suitable for ferritic steels. Both pre- and postirradiation impact tests have been completed on miniature Charpy specimens of the alloy V-15Cr-5Ti in the annealed condition (1200°C/1 hr/air cool). Irradiation was conducted in lithium filled TZM capsules at 365, 420, 520 and 600°C to doses ranging from 10 to 30 dpa. The ductile-to-brittle transition temperature was unexpectedly high in the unirradiated condition, on the order of 130°C. Impact tests demonstrate that irradiation induces a large upward shift in DBTT in this alloy. Fracture occurred primarily by transgranular cleavage in irradiated specimens at temperatures as high as 240°C. 10 refs., 5 figs., 1 tab.

20509 **(PNL-SA—15198) The influence of Mo, Si, P, C, Ti, Cr, Zr and ten trace elements on the neutron-induced swelling of AISI 316 stainless steel.** Garner, F.A. (Pacific Northwest Lab., Richland, WA (USA)). Aug 1987. Contract AC06-76RL01830. 13p. (CONF-871036—26). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003420/JAW.

From 3. international conference on fusion reactor materials; Karlsruhe, F.R. Germany (4 Oct 1987).

The individual and synergistic influences of seven major and ten minor solutes on the swelling of 316 stainless steel were investigated in an irradiation experiment conducted in EBR-II. All elements exert their influence on the duration of the transient regime of swelling, through their effect on both vacancy diffusivity and precipitate evolution, often causing a complex response with increasing solute level. On a per atom basis, phosphorus is the most effective and consistent suppressor of swelling. Trace elements were found to have no significant effect. No combination of these elements appears to suppress the tendency of this steel to swell at ~1%/dpa following the transient regime. 21 refs., 6 figs.

20510 **(PNL-SA—15247) Phase instabilities in irradiated simple Fe-Cr-Mn low activation alloys.** McCarthy, J.M.; Garner, F.A. (Pacific Northwest Lab., Richland, WA (USA)). 15 Sep 1987. Contract AC06-76RL01830. 22p. (CONF-871036—28). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003419/JAW.

From 3. international conference on fusion reactor materials; Karlsruhe, F.R. Germany (4 Oct 1987).

The Fe-Mn system has been proposed to replace the Fe-Ni system in fusion applications to achieve greatly reduced levels of long-term radioactivity. The in-reactor stability of simple Fe-Mn and Fe-Cr-Mn alloys is therefore being studied to determine the nature of the driving forces tending to destabilize these alloys. In the absence of radiation the Fe-Mn system differs from the Fe-Ni system primarily in its propensity toward mechanical twinning and the associated transformation first to hcp epsilon martensite and then to bcc alpha martensite. During irradiation, however, additional and striking differences develop due to changes in radiation-induced segregation when manganese is substituted for nickel. At higher manganese levels (≧30%) there is evidence of an additional fine scale radiation-induced decomposition similar to that observed at comparable nickel levels. The results of this study indicate that simple Fe-Cr-Mn alloys exhibit during irradiation a greater level of potential phase instabilities than do comparable Fe-Cr-Ni alloys, requiring careful attention in the development of solute-stabilized alloys. 26 refs., 8 figs., 1 tab.

20511 **(PNL-SA—15264) Effects of the neutron spectrum on mechanical property changes in low dose irradiations.** Heinisch, H.L. (Pacific Northwest Lab., Richland, WA (USA)). Sep 1987. Contract AC06-76RL01830. 31p. (CONF-871036—31). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003429/JAW.

From 3. international conference on fusion reactor materials; Karlsruhe, F.R. Germany (4 Oct 1987).

Mechanical property measurements from comparative low dose irradiations of metals and alloys are reviewed. The emphasis is on recent experiments involving miniature tensile specimens irradiated at the Rotating Target Neutron Source II (RTNS-II) at Lawrence Livermore National Laboratory and the Omega West Reactor at Los Alamos National Laboratory. Pure metals, model alloys and structural alloys have been irradiated in RTNS-II from room temperature to 723°K to fluences as high as 8×10^{22} n/m^2. Where temperature effects are apparent, the effect of increasing the irradiation temperature is to delay the onset of irradiation hardening to higher fluence. Companion fission reactor irradiations have been more limited in scope, but comparative information has been obtained on tensile properties at irradiation temperatures of 363°K and 563°K. For most of the materials tested the differences in the neutron energy spectrum can be accounted for by using displacements per atom (DPA) as a correlation parameter. Pure copper and niobium are well known exceptions. There is also evidence for rate effects in some of the data, obscuring the examination of dpa as a correlation parameter. 19 refs., 12 figs., 1 tab.

20512 **(PNL-SA—15265) The effects of low doses of 14 MeV neutrons on the tensile properties of three binary copper alloys.** Heinisch, H.L. (Pacific Northwest Lab., Richland, WA (USA)). 14 Sep 1987. Contract AC06-76RL01830;AC06-76FF02170. 18p. (CONF-871036—27). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003400/JAW.

From 3. international conference on fusion reactor materials; Karlsruhe, F.R. Germany (4 Oct 1987).

Miniature tensile specimens of high purity copper and copper alloyed respectively with five atom percent of Al, Mn, and Ni were irradiated with D-T fusion neutrons in the RTNS-II to fluences up to 1.3×10^{18} n/cm^2 at 90 C. To compare fission and fusion neutron effects, some specimens were also irradiated at the same temperature to similar damage levels in the Omega West Reactor (OWR). Tensile tests were performed at room temperature, and the radiation-induced changes in tensile properties are compared as functions of displacements per atom (dpa). The irradiation-induced strengthening of Cu5%Mn is greater than that of Cu5%Al and Cu5%Ni, which behave about the same. However, all the alloys sustain less irradiation-induced strengthening by 14 MeV neutrons than pure copper. The effects of fission and fusion neutrons on the yield stress of the copper alloys correlate well on the basis of dpa, in contrast to the behavior of pure copper. 8 refs., 6 figs., 1 tab.

20513 **(PNL-SA—15286) The influence of specimen size on Charpy impact testing of unirradiated HT-9.** Louden, B.S.; Kumar, A.S.; Garner, F.A.; Hamilton, M.L.; Hu, W.L. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1987. Contract AC06-76RL01830. 36p. (CONF-871036—32). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005173/JAW.

From 3. international conference on fusion reactor materials; Karlsruhe, F.R. Germany (4 Oct 1987).

The effect of specimen size on the impact properties of HT-9 has been studied. The data from precracked and notched-only specimens of HT-9 were used along with previously published data on other steels to develop correlations that predict from subsize specimen data the ductile-brittle transition temperature (DBTT) and the upper shelf energy (USE) anticipated for full size specimens. Each correlation is based on physical insight and can be applied equally well to both precracked and notched-only specimens. The correlation for USE works best for fracture energy in a range characteristic of irradiated materials, while a previously published correlation works better for more ductile materials. The DBTT correlation, however, works well on all materials for which sufficient data have been published. 12 refs., 4 figs., 2 tabs.

20514 **(PNL-SA—15322) Response of Fe-Cr-Mn austenitic alloys to thermal aging neutron irradiation.** Garner, F.A.; Abe, F.; Noda, T. (Pacific Northwest Lab., Richland, WA (USA); National Research Inst. for Metals, Tokyo (Japan)). Sep 1987. Contract AC06-76RL01830. 20p. (CONF-871036—29). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003415/JAW.

From 3. international conference on fusion reactor materials; Karlsruhe, F.R. Germany (4 Oct 1987).

The Fe-Cr-Mn austenitic alloy system is being studied as a replacemnet of the Fe-Cr-Ni system for fusion applications in which reduced long-term radioactivation is an important consideration. This paper describes two aspects of the respone of this alloy system to material and environmental variables. First, the neutron-induced void swelling of simple binary and ternary alloys is investigated as a function of composition, thermal-mechanical treatment, temperature (693 to 873K) and displacement level (9 to 76 dpa). The swelling rate of this alloy system approaches 1%/dpa for those conditions which do not favor formation of large levels of ferrite phases. Second, the tendency of the potentially detrimental sigma phase to form during thermal aging is explored at high manganese levels. Variables such as carbon concentration, cold-work level and aging time are shown to influence the distribution and rate of sigma formation. 18 refs., 10 figs., 1 tab.

20515 (UCLA/PPG—1123) Hydrogen pumping and release by graphite under high flux plasma bombardment. Hirooka, Y.; Leung, W.K.; Conn, R.W.; Goebel, D.M.; LaBombard, B.; Nygren, R.; Wilson, K.L. (California Univ., Los Angeles (USA). Dept. of Mechanical, Aerospace and Nuclear Engineering; Sandia National Labs., Livermore, CA (USA)). Jan 1988. Contract AS03-84ER52104. 41p. NTIS, PC A03. Order Number DE88005880/JAW.

Inert gas (helium or argon) plasma bombardment has been found to increase the surface gas adsorptivity of isotropic graphite (POCO-graphite), which can then getter residual gases in a high vacuum system. The inert gas plasma bombardment was carried out at a flux $\simeq 1 \times 10^{16}$ ions s^{-1} cm^{-2} to a fluence of the order of 10^{21} ions/cm^2 and at temperatures around 800°C. The gettering capability of graphite can be easily recovered by repeating inert gas plasma bombardment. The activated graphite surface exhibits a smooth, sponge-like morphology with significantly increased pore openings, which correlates with the observed increase in the surface gas adsorptivity. The activated graphite surface has been observed to pump hydrogen plasma particles as well. From calibrated H-alpha measurements, the dynamic hydrogen retention capacity is evaluated to be as large as 2×10^{18} H/cm^3 at temperatures below 100°C and at a plasma bombarding energy of 300 eV. The graphite temperature was varied between 15 and 480°C. Due to the plasma particle pumping capability, hydrogen recycling from the activated graphite surface is significantly reduced, relative to that from a pre-saturated surface. A pre-saturated surface was also observed to reproducibly pump a hydrogen plasma to a concentration of 9.5×10^{17} H/cm^2. The hydrogen retention capacity of graphite is found to decrease with increasing temperature. A transient pumping mechanism associated with the sponge-like surface morphology is conjectured to explain the large hydrogen retention capacity. Hydrogen release behavior under helium and argon plasma bombardment was also investigated, and the result indicated the possibility of some in-pore retrapping effect. 43 refs., 11 figs.

20516 Reentrant bakable all-metal feedthrough vacuum seal. Edmonds, P.H.; Shipley, W.D. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Journal of Vacuum Science and Technology, A: Vacuum, Surfaces, and Films;* **6**: No. 1, 165-167(Jan 1988). Contract AC05-84OR21400.

The design, construction, and testing of a reentrant metal seal are described. The principal advantages of this seal are that it occupies a minimum cross-section diameter, requires no special alignment of the components, does not need a large rotational torque to seal, and has a large margin of sealing force. Jackscrews are used to apply the sealing force.

20517 Engineering considerations for the Tore Supra pump limiter. Whitley, J.B.; Koski, J.A.; Aymar, R. (Sandia National Labs., Albuquerque, NM, USA; Association Euratom-CEA, Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance, France). pp 627-635 of Fusion technology 1986. 2 volumes. Proceedings of the fourteenth symposium, Avignon (FR), 8-12 September 1986. Oxford, England; Pergamon Press (1986). (EUR—10936-EN; CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

The Tore Supra pump limiter project is a collaboration between Sandia National Laboratories and Oak Ridge National Laboratories in the U.S. and the Association Euratom-CEA at Cadarache, France. The long pulse length and high power levels of Tore Supra, coupled with the desire to remove the maximum practical number of particles, have driven the pump limiter design beyond that ever before experienced. The engineering considerations going into this design are reviewed and several preliminary designs are discussed.

20518 Recent refractory metal fabrication experience. Heestand, R.L. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **52**: 223-224(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

This paper describes activities at Oak Ridge National Laboratory (ORNL) involving the fabrication and procurement effort to produce niobium, tantalum, tungsten, and molybdenum alloy products needed to support materials testing to be performed by SP-100 project participants; the fabrication of high-purity tungsten and thoriated tungsten products for industrial use; and recent developments in fabrication of iridium used for fuel containment in isotopic power sources.

20519 In-vacuum cyclic fatigue behavior of Vanstar-7 at elevated temperatures. Liu, K.C. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **52**: 225(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Refractory metal alloys have been proposed for fusion reactor and space power applications because of their high-temperature strength, low thermal stress properties, good compatibility with liquid-metal coolants and radiation resistance. Little is known, however, about the cyclic fatigue properties that are important to some fusion reactor systems that operate in thermal cycles. This paper presents limited results of in-vacuum cyclic fatigue tests on Vanstar-7 (9 Cr-3 Fe-Zr) at room temperatures, 550, and 650°C. Miniature hourglass-shaped specimens were used with a gauge diameter of 3.18 mm. The material was annealed 1 h in vacuum at 1400°C before machining, to produce an average grain size of ASTM No.7. The specimens were stress relieved for 0.5 h at 1400°C after machining.

20520 Experimental modeling of eddy currents and deflections for tokamak limiters. Hua, T.Q.; Knott, M.J.; Turner, L.R.; Wehrle, R.B. (Argonne National Lab., IL). *Transactions of the American Nuclear Society;* **52**: 233-234(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

In this study, experiments were performed to investigate deflection, current, and material stress in cantilever beams with the Fusion ELectromagnetic Induction eXperiment (FELIX) at the Argonne National Laboratory. Since structures near the plasma are typically cantilevered, the beams provide a good model for the limiter blades of a tokamak fusion reactor. The test pieces were copper, aluminum, phosphor bronze, and brass cantilever beams, clamped rigidly at one end with a nonconducting support frame inside the FELIX test volume. The primary data recorded as functions of time were the beam deflection measured with a noncontact electro-optical device, the total eddy current measured with a Rogowski coil and linking through a central hole in the beam, and the material stress extracted from strain gauges. Measurements of stress and deflection were taken at selected positions along the beam. The extent of the coupling effect depends on several factors. These include the size, the electrical and mechanical properties of the beam, segmenting of the beam, the decay rate of the dipole field, and the strength of the solenoid field.

20521 Behavior of graphites under intense heat loads. Bohdansky, J.; Croessmann, C.D.; Linke, J. (Sandia National Labs., Albuquerque, NM, USA). pp 1063-1068 of Fusion technology 1986. 2 Vols. Proceedings of the fourteenth symposium, Congress Center of the Palais des Papes, Avignon, France, 8-12 September 1986. Oxford, England; Pergamon Press (1986). (EUR—10936-EN; CONF-860917—).

From 14. SOFT - symposium on fusion technology; Avignon, France (8 Sep 1986).

Graphite is used in most tokamak experiments as a first wall material, due to its excellent thermal shock resistance, low-Z mass, and high sublimation temperature, but due to the high porosity gas absorption can create a severe problem. Besides outgassing, chemical erosion and sublimation can also contribute to impurity introduction into the plasma. In this experiment the behavior of graphitic materials has been tested under high heat loads. Emphasis was laid on the following aspects: - thermomechanical properties (cracking behavior) -thermal erosion behavior (weight loss, surface modifications) -outgassing behavior (25 - 1600/sup 0/C).

20522 **Configuration development and structural assessment of the FEDC ignitor concept.** Brown, T.G.; Lee, V.D.; Mayhall, J. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **52**: 136-137(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The Oak Ridge National Lab. Fusion Engineering Design Center (FEDC) has developed a compact ignition device based on the design approach established by Coppi of the Massachusetts Institute of Technology in his Ignitor concept. Ignitor uses preload of the inner toroidal field (TF) coil leg along with bucking of the TF coil against the ohmic heating (OH) solenoid to minimize the size of the ignition device. Emphasis has been placed on the configuration design of the reactor core module and the external, hydraulic preload system. A structural evaluation of all the major components of the FEDC Ignitor was performed during the design configuration development. These components include the reactor core assembly, the TF coil torque structure, and the preload structure. Also as part of the compact ignition studies program, a material properties task force evaluated the copper materials considered for the coils in all the concepts developed under the program. The main purpose of the task force was to develop a structural design criteria specifically for the compact ignited device using only the specified copper alloys.

20523 **Maintainability features of the Compact Ignition Tokamak.** Spampinato, P.T.; Bushnell, C.W. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **52**: 139-141(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The compact ignition tokamak (CIT) is a deuterium-tritium (D-T) device envisaged to be the next experimental reactor in the US Fusion Program. The reactor will initially operate in a nonactivated hydrogen phase for ~ 2 yr. This will permit verification of the integrity of the total system and allow hands-on repair to equipment that has experienced shakedown and early operation failures. Once D-T operations commence, reactor maintenance will require remote handling techniques. An evaluation has been completed to determine what maintenance operations must be performed on the CIT. A maintenance philosophy has been developed that is based on the use of manipulator systems and robotics in the test cell. Replacement of life-limited equipment will be accomplished using a modular design approach for components, with simple remotely operable interfaces.

20524 **Rotating shield roof for high-field ignition experiment test cell.** Commander, J.C. (EG & G Idaho Inc., Idaho Falls). *Transactions of the American Nuclear Society;* **52**: 141-142(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

This work was done as part of the preconceptual design of buildings and utilities for the high-field ignition experiment (HFIX). The functional and operational requirements (F & ORs) developed in the HFIX Buildings and Utilities Requirement Document provide one basis for the preconceptual design. A second basis was provided by the assumption that the HFIX project will be sited at the Princeton Plasma Physics Lab. (PPPL) and that maximum utilization will be made of existing buildings and utilities to satisfy HFIX buildings and utilities F & ORs. Specifically, the F & ORs developed were matched against existing PPPL buildings and utilities, including the Tokamak Fusion Test Reactor buildings and utilities, in order to minimize the cost of modifications and of new buildings and site utilities. Results of this review indicate a new test cell would be required for HFIX, and preconceptual design was initiated. The rotating shield roof design was formulated during the preconceptual design as the best approach to satisfaction of the HFIX test cell F & ORs.

20525 **Tensile behavior of helium-implanted and neutron-irradiated.** Grossbeck, M.L.; Horak, J.A. (Oak Ridge National Lab., TN). *Transactions of the American Nuclear Society;* **52**: 154-156(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

Vanadium alloys are being considered for use for first-wall and blanket structures in fusion reactors due to their high melting points and low neutron activation. The alloy reported on here, V-15 Cr-5 Ti, was prepared by the Westinghouse Advanced Reactors Division (Heat HSV-307). Since the fusion environment produces helium in all common structural alloys including vanadium, the effect of helium in irradiated alloys was investigated. In a fusion reactor spectrum, ~ 5 at. ppm He/dpa is expected. Ideally, the helium should be produced concurrently with displacement damage. However, since this is difficult or impossible in vanadium without a source of high-energy neutrons, cyclotron implantation of helium followed by fission reactor irradiation was chosen. By this method, it was hoped to scope qualitatively the effect of helium alone and the synergistic effect of helium in conjunction with neutron irradiation. Results show that: (1) cyclotron injection of 80 at. ppm He has little effect on mechanical properties of V-15 Cr-5 Ti at 700 and 625°C and causes a factor of ~ 2 reduction in elongation at 400°C; and (2) neutron irradiation to 24 to 32 dpa increases the strength of annealed V-15 Cr-5 Ti by a factor of ~ 2 and decreases ductility by a factor of about 10.

20526 **Evaluation of cooling channel configurations for actively cooled limiters.** Koski, J.A.; Whitley, J.B. (Sandia National Lab., Albuquerque, NM). *Transactions of the American Nuclear Society;* **52**: 165-166(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The purpose of the present investigation is to simulate experimentally the one-sided heating geometry encountered in fusion devices, and to assess the applicability of existing critical heat flux (CHF) and heat transfer correlations to this geometry. The Sandia National Lab. electron beam test system (EBTS) was used to heat one side of 7.7- and 12.7-mm-i.d. copper tubes. A single tube placed horizontally in the EBTS vacuum chamber was heated on the top by a rastered 30-kV electron beam. The test section was cooled with water supplied by a centrifugal pumped closed-loop system. Coolant inlet and exit pressures, flow rate, inlet temperature, and temperature rise were measured as were the target's surface and backside temperatures. Water calorimetry was used to determine the actual delivered power, with all system operation and data collection under computer control. The flow within the heated region was studied by viewing directly through the tube. Comparison of experimental data for one-sided heating of tubes with high subcooling to existing empirical correlations for CHF and heat transfer indicates that care must be taken in applying the correlations. For the range of data considered, the peak surface heat flux is indicated as the proper parameter to use when applying CHF correlations. For estimating heat transfer, a combination of Thom's equation and the Dittus-Boelter equation was reasonably successfully in analyzing one-sided heat transfer in the highly subcooled flow region.

20527 **Development of a high-vacuum, high-temperature movable limiter support.** Brown, G.W. (Sandia National Lab., Albuquerque, NM). *Transactions of the American Nuclear Society;* **52**: 166-168(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

The Advanced Limiter Test-II is a full toroidal belt pump limiter for the Tokamak Experiment for Technology Oriented Research (TEXTOR), consisting of eight curved blade segments that extend around the full circumference of the machine. The blades are supported at their ends from TEXTOR's Inconel liner by 16 worm gear screw jacks, which allow the positions of the limiter blades to be adjusted relative to the plasma centerline. Mechanical linkages and rotary feedthroughs link each jack to a drive motor outside the vacuum vessel. This allows the TEXTOR operators to adjust the positions of the blades remotely without opening the machine to the atmosphere. The lubricants and materials normally used in mechanical drive components are unacceptable in the tokamak environment. A prototype jack mechanism was designed and built with a Type 316L stainless steel housing and two sets of moving parts. The first set consisted of Nitronic 60 parts running against parts of aluminum bronze (CDA 642). The second set was made entirely of Nitronic 60. All running surfaces were coated with Dicronite, a WS_2 solid film lubricant. High vacuum, high temperature tests of these are reported in this paper.

20528 Contamination of aluminum and painted surfaces exposed to tritium. Jalbert, R.A.; Brereton, S.J.; Holland, D.F. (Los Alamos National Lab., NM). *Transactions of the American Nuclear Society;* **52**: 251-253(1986). (CONF-860610—).

From American Nuclear Society annual meeting; Reno, NV, USA (15 Jun 1986).

There are a number of facilities in the world that handle large quantities of tritium. Many more are envisioned as deuterium-tritium-burning fusion test and power reactors come on line. To cope with increasing environmental concerns, many of the designs of such facilities will probably incorporate some type of emergency air detritiation system. To better design the ventilation and detritiation systems for such facilities, more data are needed regarding the conversion of HT to HTO under realistic release conditions and the uptake and subsequent release (outgassing) of surfaces contaminated by airborne tritium. Surface contamination studies begun several years ago at the Los Alamos National Lab. using small, painted samples were recently expanded using a large exposure chamber. This paper summarizes the results of the earlier unpublished work and compares the newest data with recently reported results and their implication for tritium facilities.

99 GENERAL AND MISCELLANEOUS

20529 (CEA-INDUSTRIE-RA—1986) Group CEA industry: exercise of 1986. (CEA, 75 - Paris (France)). 1987. 100p. (In French). NTIS (US Sales Only), PC A05/MF A01. Order Number DE88751568/JAW.

From the end of 1983, the whole affiliates and participations of CEA are hept by CEA-industry. The group activity is principally in the nuclear field. Cogema and the whole fuel cycle, construction, maintenance, improvement of nuclear power plants, research reactors and naval propulsion boilers and the sector Power plants and nuclear services (Framatome, Technicatome, Intercontrole, Stmi, principally). A non-nuclear sector comes from new techniques or activities developed for the nuclear needs: computer science (CISI), biomedical field (ORIS-industrie), different activities such as ultrafiltration or robotics-productics.

20530 (CEA-RA—1986) CEA Annual progress report 1986. (CEA, 75 - Paris (France)). 1987. 102p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE88751574/JAW.

This annual report presents the general organization of the CEA, the international relations and politics in nuclear field, the activities (military application, nuclear applied research, ANDRA (National Agency for Radioactive Waste Management), nuclear safety and protection, fundamental research, applied research other than nuclear), the industrial group; among topics about men and means, the budget execution of the public establishment of research. In annex, the nuclear power plants around the world and the principal legislative texts related to CEA or atomic energy published in 1986.

20531 (CONF-8706230—2) An integrated energy planning model: Interface between energy planning and environmental impacts. Wolsko, T.D.; Cirillo, R.R.; Habegger, L.J.; Peerenboom, J.P. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 67p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88003058/JAW.

From World Bank's meeting of the regional energy planning project at the International Atomic Energy Agency; Vienna, Austria (22 Jun 1987).

Integrated energy planning is a process that develops information relevant to decisions regarding the energy supply and management system. Its scope includes the selection of new technologies and the operation of the supply system, as well as the management of supplies (i.e., full allocation, tariff structure). In addition to these direct economic factors of energy supply, integrated energy planning should include proper consideration of social cost factors, such as environment, health, and safety. Purpose of this paper is to describe an integrated energy planning approach and an integrated energy planning model, and to provide a simple structure for performing integrated energy planning case studies that include environmental impacts. 41 refs., 18 figs., 10 tabs.

20532 (CONF-8711139—1) Foreign students and foreign-born scientists and engineers in the US work force. Finn, M.G. (Oak Ridge Associated Universities, Inc., TN (USA)). 1987. Contract AC05-76OR00033. 11p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004594/JAW.

From Meetings of the Society for Social Studies of Science; Worcester, MA, USA (19 Nov 1987).

This paper summarizes some earlier findings regarding the stay rate of foreign students and then addresses two questions about which we have scant information at present. One question is concerning the geographic origin of foreign nationals working in the United States. The second is related to the stay rate of foreign students: What is the emigration rate of foreign-born scientists and engineers once they have become a part of the US work force?

20533 (DOE/ER/75172—5) Nuclear technology for the year 2000. (American Nuclear Society, La Grange Park, IL). 1987. Contract FG02-85ER75172. 112p. (CONF-8703231—Summs.). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88005041/JAW.

From Western region American Nuclear Society student conference: nuclear technology for the year 2000; Albuquerque, NM, USA (19 Mar 1987).

Eighteen papers and abstracts are presented under the following session headings: space nuclear power, health physics and dosimetry, nuclear design and thermal hydraulics, nuclear diagnostics, and fusion technology and plasma physics. The papers were processed separately for the data base. (DLC)

20534 (DOE/ID—10177) Guide to good practices for on-the-job training. (EG and G Idaho, Inc., Idaho Falls (USA)). Sep 1987. 370p. NTIS, PC A16/MF A01; 1; GPO Dep. Order Number DE88003771/JAW.

This manual is intended to provide DOE reactor and non-reactor nuclear facilities with guidelines for the development and implementation of facility specific, performance-based, On-the-Job Training (OJT) programs. An OJT Instructor Training Course is included to train the first-line supervisor and other designated personnel as OJT instructors. The subject matter content and level of detail were determined based upon a review of material obtained from DOE documents, INPO Guidelines, and input from selected DOE contractors. The final draft version of the manual was reviewed for accuracy, clarity, and comprehensiveness by trainers from the following DOE Contractors/Laboratories: Argonne National Laboratory - West - Idaho National Engineering Laboratory, E.I. DuPont - Savannah River Plant, EG and G Idaho, Inc. - Idaho National Engineering Laboratory, Los Alamos National Laboratory, Martin Marietta - Oak Ridge National Laboratory, Rockwell International - Rocky Flats Plant, and Westinghouse Hanford Co.

20535 (DOE/IG—0247) Recovery of costs related to patent rights waived to contractors or inventors. (USDOE Office of Inspector General, Albuquerque, NM. Western Regional Office). Dec 1987. 18p. OSTI, PO Bx 62, Oak Ridge, TN 37831. Order Number TI88004716/JAW.

Our review showed that the Department had not recovered all patent application and prosecution costs for waivers granted to M & O contractors and employee-inventors. The operations offices and M & O contractors used different and inconsistent methods of computing these costs. The precise amount of the under-recovery could not be accurately determined. However, we estimated the under-recovery on 34 patents waived at the Lawrence Livermore and Los Alamos during FY 1984 through 1986 was about $187,000.

20536 (DOE/IG—0249) The Department of Energy's audit resolution and followup system. (USDOE Office of Inspector General, Washington, DC. Capital Regional Office). 15 Jan 1988. 19p. OSTI, PO Bx 62, Oak Ridge, TN 37831. Order Number TI88005869/JAW.

Report to The Secretary.

Purpose of our audit was to determine whether corrective actions on operational audit reports had been properly and promptly resolved and implemented and to followup on two prior reviews of the Department's resolution and followup system. Based on our review of selected recommendations, we concluded that the

Department's audit resolution and followup system has been effective. We found, however, instances where corrective action on recommendations were inadequate or incomplete and that recommendations had remained open for a year or more after audit resolution. Also, a revised DOE Order on audit resolution had not been finalized. A summary of management's comments on our recommendations and our response are summarized in Part III of the report. Management's proposed actions, when implemented, will be responsive to the recommendations.

20537 **(DOE/MA—0322) Listing of awardee names: Active awards as of January 11, 1988.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Review and Analysis). 11 Jan 1988. 629p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE88005246/JAW.

This is a computerized listing issued quarterly from the Procurement and Assistance Data System (PADS), including an alphabetical listing of all acquisition and financial assistance awards (excluding purchase orders) with the Department of Energy. Active is defined as the completion date of the award is later (in the future) than the date of the issuance of the listing.

20538 **(DOE/NV/10359—T1) A guide to archival collections relating to radioactive fallout from nuclear weapon testing: Sixth edition.** (History Associates, Inc., Rockville, MD (USA)). May 1987. Contract AC08-84NV10359. 89p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE88003143/JAW.

This volume is the result of a search conducted for documents related to the fallout from nuclear weapons testing at the Nuclear Testing Site. The guide is organized alphabetically by the names of the record repositories, not by the organizations which have custody of the records. The materials are described in such a way that it is possible to determine the nature of the information in, and the quality of, each record collection. For each entry, a contact person is given where possible. (JDH)

20539 **(DOE/OR/21400—T326) Corporate and personal values: Working together productively.** Vaughen, V.C.A. (Oak Ridge National Lab., TN (USA)). 9 Nov 1987. Contract AC05-84OR21400. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002678/JAW.

This document consists of material on business, corporate, and engineering ethics. (DLC)

20540 **(DOE/OR/21702—T2) A national model at Howard University demonstrating private sector interrelationships that facilitate research in predominantly black colleges and universities.** (Howard Univ., Washington, DC (USA)). 1987. Contract FG05-86OR21702. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003433/JAW.

Support provided by DOE has been used to facilitate the advancement of research alliances at Howard University, North Carolina A & T State University, Morgan State University and other historically black colleges and universities. The nation's economy is increasing by the developing and commercialization of new technologies and training of future scientists and engineers. President Reagan, in his 1987 State of the Union address, proposed several initiatives to enhance the nation's economic competitiveness, including the establishment by federal research agencies centers of science and technology. The President described these centers as "new university-based interdisciplinary science and technology centers" that will focus on fundamental science that directly contributes to the nation's economic competitiveness. Phase One of the grant from DOE has been used to promote and develop research centers of excellence in historically black colleges and universities.

20541 **(LA-UR—87-4288) Recognizing women in the archaeological record.** Bumsted, M.P. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 10p. (CONF-880142—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88004298/JAW.

From American Anthropological Association meeting; Chicago, IL, USA (1 Jan 1988).

Primary sexual characteristics are usually absent in the archaeological record. The recovered secondary sex markers in bone morphology or mortuary context reflect the lifelong integrated biocultural experience of the individual man or woman. Internal patterns of variability within and between sexes can be recognized but are too frequently masked by traditional descriptive and univariate analyses. Fortunately, a more detailed picture of life experience is gained by analyzing chemical composition (isotopic and elemental) of hard tissues using an analytical anthropology approach and by examining the variation in novel ways. 7 figs.

20542 **(NRPB-GC—5) New radiation quantities recommended by ICRU for practical use in radiological protection: their implementation in the United Kingdom.** (National Radiological Protection Board, Chilton (UK)). Jun 1986. 37p. H.S. Stationery Office, London, price Pound 5.00.

This report considers the practical application of both the ICRU Report No. 39 and the ICRP Statement of 1985 and recommends the implementation of the ICRU operational quantities in the United Kingdom but, at this stage, the increase in the Q values for neutrons is not recommended. No other changes in Q are expected for some years.

20543 **(ORNL/TM—10597) Hiring handicapped persons is no handicap.** Eggers, J. (Oak Ridge National Lab., TN (USA)). Dec 1987. Contract AC05-84OR21400. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004081/JAW.

Persons having handicaps have been more likely to be hired into hourly and weekly job categories than into professional categories. The extent to which this selectivity reflects the qualifications of applicants rather than prejudicial categorization of handicapped persons is unknown. Only 5% of all handicapped high school graduates enter college, as compared with 34.3% of nonhandicapped high school graduates, thus decreasing the availability of handicapped applicants for professional jobs. The data presented here on absenteeism from on-the-job injuries, illness, and personal leave and on frequency of turnover indicate that concern about these matters is no more justified in considering handicapped persons for employment than nonhandicapped persons. An interesting statistic is the increase in absences for both groups in the second year of employment. Turnover data indicate that employees who leave do so in the largest numbers during their first year of employment. These results should not be construed to mean that the supervisor of a handicapped person has never had nor ever will have a problem with safety, attendance, or turnover; the results do suggest that these problems are no greater for handicapped than nonhandicapped employees. 1 ref., 7 tabs.

20544 **(RFP—4073) Manufacturing error management.** Burnham, M.W. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). [1987]. Contract AC04-76DP03533. 20p. NTIS, PC A03. Order Number DE88005280/JAW.

This collection of vugraphs presents a brief, crude, and nearly useless assessment of accuracy and source of error as applied to machining. (JDH)

20545 **(SAND—87-2871) Target-reflectivity models for various terrain types.** Froehlich, G.K. (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 20p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005510/JAW.

In the first section of this report, measured data are used to calculate Fresnel-reflection coefficients for several terrain types. In the next section, scattering-terrain models are fit to the same data. In the third and final section, the author uses the parameters of the scattering-terrain models to find equivalent Fresnel-reflection coefficients; these are compared to those found in the first section, thus serving as a measure of the applicability of the models. 5 tabs.

9901 Management

20546 **(AERE-OR/EMS—14) Health Physics and Medical Services report for 1986.** Burt, A.K.; Bird, R.W. (UKAEA Harwell Lab. Environmental and Medical Science Div.). Sep 1987. 61p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751822/JAW.

A Health Physics and Medical Services report is presented for Harwell Laboratory for 1986. Health physics aspects covered include safety policy and organisation, monitoring results for the working environment and personnel, an analysis of radiological incidents and radioactive waste disposal, and protection of the public. Other non-radiological aspects of health and safety are briefly considered. The section on Medical Services contains details of the staffing, the types of medical examinations performed, the treatments received, work on the safety of asbestos and manmade mineral fibres and training and education programmes.

20547 **(AERE-PR-EMS—12) 1984 progress report Environmental and Medical Sciences Division.** Morgan, A.; Playford, K. (UKAEA Atomic Energy Research Establishment, Harwell. Environmental and Medical Sciences Div.). Apr 1987. 122p. H.M. Stationery Office, London, price Pound 8.00.

The 1984 Progress report is presented for the Environmental and Medical Sciences Division at AERE, Harwell excluding the Health Physics and Medical Groups. Subjects covered include radiation biophysics and dosimetry, the nuclear environment, the effects of inhaled actinides on the lung and the uptake and metabolism of toxic and trace elements by man, analytical research and development, non-nuclear atmospheric pollution and environmental safety. (U.K.).

20548 **(AERE-PR/TP—42) Theoretical Physics Division progress report. January 1985 - October 1985.** (UKAEA Atomic Energy Research Establishment, Harwell. Theoretical Physics Div.). Apr 1986. 178p. H.M. Stationery Office, London, Price Pound 11.00.

The progress report of the Theoretical Physics Division of the United Kingdom AERE Harwell Laboratory for 1985/6 is presented. The Division is divided into four groups i.e. Theory of Solid State and Quantum Physics Group, Radiation Damage and Theoretical Metallurgy Group, Statistical Physics Group, and Theory of Fluids Group. A summary of the work of each group is given, along with the research programmes carried out. (U.K.).

20549 **(CBPF-CS—012/86) Planning and implementation of nuclear research programmes.** Lopes, J.L. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1986. 24p. (CONF-860937—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701418/JAW.

From International symposium on the significance and impact of nuclear research in developing countries; Athens, Greece (8 Sep 1986).

The planning and implementation of nuclear research programmes in developed and developing countries is discussed. The main aspects of these programmes in USA, France, Japan, India and Brazil are reported. (M.W.O.).

20550 **(CUED-D-SOILS-TR—168) Glossary of terms used in nuclear industry.** Lau, F.S. (Cambridge Univ. (UK). Dept. of Engineering). 1986. 175p. British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks., LS23 7BQ.

The paper contains a glossary of terms used in the nuclear industry, in alphabetical order. The glossary was prepared by the Engineering Department, University of Cambridge, United Kingdom. (U.K.).

20551 **(DOE/IG—0248) Audit of the Department's aircraft management.** (USDOE Office of Inspector General, Albuquerque, NM. Office of Audits). Dec 1987. 21p. OSTI, PO Bx 62, Oak Ridge, TN 37831. Order Number TI88005485/JAW.

Report to The Secretary.

Purpose of the audit was to determine whether the Department's management of aircraft was efficient and economical and consistent with OMB and Departmental policies and regulations. We focused on the Department's implementation of OMB Circular A-126 with the main concern being the management system controlling aircraft operations at the Departmental level. Our review showed that the Department did not have a comprehensive and effective system to manage its aircraft program having a $34 million annual operating cost and that the aircraft management requirements established in OMB Circular A-126 had not been fully implemented. A summary of management's comments and our response are included in the report.

20552 **(EGG-M—35287) A plan for structured management of the Systems Approach to Training (SAT) process.** Schurman, D.L. (EG and G Idaho, Inc., Idaho Falls (USA)). 1987. Contract AC07-76ID01570. 4p. (CONF-8710272—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005636/JAW.

From Military Testing Association meeting; Ottawa, Canada (19 Oct 1987).

This paper describes the plan and accomplishments for development of a Systematic Management Plan for the Systems Approach to Training (SMPSAT). This project is sponsored by the United States Marine Corps Headquarters training policy branch [HQMC(TAP)]. Purpose of this effort is to develop a comprehensive plan for management of the Systems Approach to Training (SAT) system in the USMC. This management plan will allow HQMC to monitor the SAT system in order to provide maximum support to the SAT system in both the formal schools and the Fleet Marine Force.

20553 **(FRADOC—10-5) Industrial aspects of nuclear energy: French experience.** Lebreton, G. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Nov 1986. 32p. (CONF-8611216—). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751878/JAW.

From Workshop on nuclear power; Al-Kuwayt, Kuwait (2 Nov 1986).

France decides to develop nuclear energy on a wide scale about 12 years ago. To cope with this ambitious program, the roles have been distributed within a very cohesive organization, as follows: EDF, the french national electricity utility is owner, prime contractor, and plant operator. The Atomic Energy Commission, CEA performs part of the research and development work, and supplies the necessary technical support to the safety authorities. A few leading industrial firms design and build the major parts of the nuclear power plants. Among them is Framatome, which is responsible for the design, manufacture, erection, and startup of nuclear steam supply systems (the NSSSs), and related auxiliaries. Alsthom is responsible for the supply of the turbine and its auxiliaries. It would not be proper to describe the French nuclear industry without focussing our attention on the care given to transfer of technology. Technology transfer agreements can take several forms, but local factors have to be taken into account. These forms are discussed in this paper. A typical and highly significant example (KNU 9-10 project) is given.

20554 (INIS-BR—910, pp 10) **Development of NMR in Brazil.** Reeves, L.W. (Waterloo Univ., Ontario, Canada. Dept. of Chemistry). 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

20555 **(INIS-GB—109) National Nuclear Corporation Limited report and financial statements 31 March 1987.** (Touche Ross International, London (UK); National Nuclear Corp. Ltd., Knutsford (UK)). 1987. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751831/JAW.

The paper presents the annual report and audited financial statements of the National Nuclear Corporation Limited, 31 March

1987. The company is engaged in designing and constructing power stations and nuclear power reactors and other related work. A review of the development work carried out on power stations is briefly given, along with the research and development work on reactors. Future prospects concerning the Sizewell-'B' project are briefly outlined. (U.K.).

20556 **(INIS-GB—115) Chief Constable's annual report 1986.** (UKAEA Headquarters, London). 1987. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751913/JAW.

The nature of the UKAEA constabulary, its personnel, administration and training, are all covered in this report. The crimes recorded at the UKAEA and BNFL sites are analysed. Traffic problems, transport and communications are covered. Miscellaneous police functions (eg lost property), the constabulary social activities and visitors to nuclear establishments are mentioned. The report ends with a policy statement on the aims and objectives of the constabulary. The report covers 1986. (U.K.).

20557 **(INIS-mf—11032, pp 51-55) Current development of coal industry in the world.** Imramovsky, I. 1986. (In Czech). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88780032/JAW.

In VUPEK Newsletter 1/86.

A brief outline is given of power generation in nuclear power plants in the whole world, and the estimated development to the year 2000. Special attention is devoted to development in France, the FRG, Japan and the USA. (J.B.).

20558 **(KFA-ASS—0460) Nuclear Research Centre Juelich. 1986 annual work report of the Department for Safety and Radiation Protection.** Hille, R. (ed.); Frenkler, K.L. (comp.). (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Abt. Sicherheit und Strahlenschutz). Feb 1986. 236p. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE88752261/JAW.

The Department for Safety and Radiation Protection continues to be responsible for coordinating radiation protection, safety and protection at the KFA. It supports the other institutes and departments in performing the safety tasks allotted to them. The principal tasks of the Department are in administrative and technical assistance to these organization units and in safeguards. Administrative assistance involves, for example, regulation of the radiation protection organization in the institutes, including the appointment of radiation protection officers (Strahlenschutzbeauftragte). Furthermore, this includes the central handling of the registration system with the authorities and dealing with outside firms thus considerably relieving the institutes of their administrative tasks. Handling licensing procedures and the central accountancy of radioactive materials is also to be mentioned in this context. Technical assistance largely consists of developing, maintaining and repairing radiation measuring instruments and in the monitoring of personnel by evaluating personnel dosimeters and incorporation controls for radioactive sources. The safeguards tasks of the Department concern the very staff-intensive physical protection, as well as environmental protection and industrial safety.

20559 **(LA—10547-MS) Conceptual Specification for Defensive Technology Evaluation Code (DETEC).** Christman, R.D.; Dana, A.L.; Henderson, D.B.; Shafer, B.P.; Wood, J.A.; Wood, M.M. (Los Alamos National Lab., NM (USA)). Jan 1986. Contract W-7405-ENG-36. 123p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE86008568/JAW.

The Defensive Technology Evaluation Code (DETEC) is being developed to assess the potential of a realistically diverse assortment of strategic defense and offense assets deployed on all sides in possible global conflict. Principal applications of the code will be to study the roles of the various weapon technology concepts being explored for strategic defense. Technology requirements and sensitivities will be studied in the context of complete wars built up from many individual one-on-one engagements. DETEC will also provide an important vehicle with which to develop and test various possible algorithms for battle management and for communications and control.

20560 **(OEFZS—4405) Progress report 1986. Abridged version.** Schwach, G.W. (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H. Stabsabteilung Forschungsplanung und Technologieprognose). (Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H.). Jul 1987. 34p. (In German). (FO—37/87). NTIS (US Sales Only), PC A03/MF A01. Order Number TI88701530/JAW.

The status of projects in the five research areas is given: Energy and safety. Materials research, isotope- and radiation technology. Measurement techniques and information processing. Environment protection, health and nutrition. Counselling for industry and enterprises. (qui).

20561 **(PNL—6435) Automation impact study of Army Training Management.** Sanquist, T.F.; Schuller, C.R.; McCallum, M.C.; Underwood, J.A.; Bettin, P.J.; King, J.L.; Melber, B.D.; Hostick, C.J.; Seaver, D.A. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1988. Contract AC06-76RL01830. 216p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE88005550/JAW.

The main objectives of this impact study were to identify the potential cost savings associated with automated Army Training Management (TM), and to perform a cost-benefit analysis for an Army-wide automated TM system. A subsidiary goal was to establish baseline data for an independent evaluation of a prototype Integrated Training Management System (ITMS), to be tested in the fall of 1988. A structured analysis of TM doctrine was performed for comparison with empirical data gathered in a job analysis survey of selected units of the 9ID (MTZ) at Ft. Lewis, Washington. These observations will be extended to other units in subsequent surveys. The survey data concerning staffing levels and amount of labor expended on eight distinct TM tasks were analyzed in a cost effectiveness model. The main results of the surveys and cost effectiveness modelling are summarized. 18 figs., 47 tabs.

20562 **(WHC-SA—0121) Accreditation: Making and meeting your own standards.** Birk, S.M. (Westinghouse Hanford Co., Richland, WA (USA)). Oct 1987. Contract AC06-87RL10930. 44p. (CONF-8710184—6). NTIS, PC A03. Order Number DE88004472/JAW.

From 11. annual Training Resources and Data Exchanges (TRADE) conference; Atlanta, GA, USA (26 Oct 1987).

This document is a compilation of viewgraphs and worksheets on writing standards for training people and businesses to comply with regulations, organization, training staff, facilities, and instructional system design are covered. (DLC)

20563 **(Zfl-Mitt—130) 1986 annual report of the Central Institute for Isotope and Radiation Research.** (Akademie der Wissenschaften der DDR, Leipzig. Zentralinstitut fuer Isotopen- und Strahlenforschung). Jun 1987. 294p. (In English, German). NTIS (US Sales Only), PC A13/MF A01. Order Number TI88701538/JAW.

Most of the 1986 publications of the Zentralinstitut fuer Isotopen- und Strahlenforschung are presented as abstracts. Author and subject indexes are included.

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REFER ALSO TO CITATION(S) 18237, 19986

20564 **(ANL/TM—458) ANL Statement of Site Strategy for computing workstations.** Boxberger, L.M.; Caruthers, C.M. (ed.). (Argonne National Lab., IL (USA)). Oct 1987. Contract W-31109-ENG-38. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005319/JAW.

The Statement of Site Strategy consists of eighteen chapters that together explain the overall Argonne strategy for defining, acquiring, using, and evaluating computing workstations and other automated office support systems. The six appendices clarify Argonne's responsibilities in managing microprocessors and word processors and in acquiring computing workstation components. Appendix E contains the justification form required for acquiring computing workstation equipment, software, or peripherals.

20565 (CEA-CONF—9048) Intelligent use of knowledge in the EUM system. Starynkevitch, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. d'Etudes Mecaniques et Thermiques). May 1987. 9p. (In French). (CONF-8705239—). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751347/JAW.

From COGNIVITA '87; Paris, France (18 May 1987).

A system accepting truely descriptive knowledge should receive (on build) meta-knowledge for using knowledge. The EUM system, in development, described in this paper, accepts such a knowledge. On the bottom level, it is a programming language (or a virtual machine) designed to be able to self-improve by introspection. Upper levels use meta-knowledge. EUM can access all objects its uses, it executes orders by using explicit methods. These can be meta-expertises. Hence, EUM can reason about its own operation, and cleverly use its knowledge and methods. Interaction with user is done by orders; thus it can be expertly driven. The initial inference engine is made of modules which can be replaced or completed by meta-expertises, of which some partial examples are given. Hence, it is possible to extend the knowledge langage, and the inference mechanism, by meta-expertises. In the same way, knowledge bases can be expertly compiled into orders.

20566 (HMI-B—438) Representation, testing and assessment of the 'Estelle' formal description technique from a computer-controlled neutron scatter experiment. Wolschke, U. (Hahn-Meitner-Institut Berlin G.m.b.H. (Germany, F.R.). Bereich Kernchemie und Reaktor; Technische Univ. Berlin (Germany, F.R.). Fachbereich 20 - Informatik). Aug 1986. 130p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE88751500/JAW.

Estelle is a formal method of description, which was developed based on an extended state transition model for the specification of communication records and services. Regardless of the field of application, there are problems common to all systems in distributed systems, i.e. in communication systems as in process computer systems, which are to be specified. These include real time problems, such as waiting for events, reactions to expected events and those occurring at the correct time, reacting to unexpected events or those not occurring at the correct time, transmitting and receiving data and the synchronisation of process going on simultaneously. This work examines, using the example of a process computer-controlled neutron scatter experiment, whether Estelle is suitable for the specification of distributed real time systems in this field of application.

20567 (LPC—87-04) Use notice of an interactive program: SPADFACIL. Eschylle, R. (College de France, 75 - Paris. Lab. de Physique Corpusculaire). 1987. 10p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88751760/JAW.

Spadfacil is an interactive program whose use is to guide the user step by step in creation of files used in principal component analysis, simple or multiple correspondence analysis. For definition of modules included in each file, see the user manual of Spaf software (LPC–87-05).

20568 (AD-A—185475/1/XAB) Real-time systems using local-area networks. Technical report. Levi, S.T.; Tripathi, S.K. (Maryland Univ., College Park (USA). Inst. for Advanced Computer Studies). Jul 1987. 39p. (UMIACS-TR—87-35). NTIS, PC A03/MF A01.

Design and implementation of a real-time communication network has to meet goals of fault-free and timely delivery of messages, as defined by the applications served by the network. The time constraints of the applications are projected as stringent constraints on the local knowledge of time. However, the local knowledge of time in a distributed system requires the use of the communication network. The accuracy and coherence of this knowledge depend on the way clocks are synchronized. Therefore, the performance of clock-synchronization algorithms due to the communication network, is a good criterion for analyzing the adequacy of a particular network architecture to real-time application. This paper examines the adequacy of LAN architecture for real-time applications through a delay model of a typical LAN. The model is applied to various clock-synchronization algorithms, and error estimates for these algorithms are derived. An efficient environment, in which the uncertainties in message-communication elapsed time is significantly reduced, is then described for layered protocol architecture. In addition, it is shown that predictable communication elapsed time can be compensated for in synchronization algorithms, significantly reducing the errors of these algorithms.

20569 (AD-A—185589/9/XAB) Parallel PDE (partial differential equations) algorithms and supercomputer architecture. Annual report. Rice, J.R. (Purdue Univ., Lafayette, IN (USA). Dept. of Computer Science). 1985. 3p. NTIS, PC A02/MF A01.

This report covers activities of John R. Rice (PI) and associates since October 1984. The activity of Kai Hwang is reported separately because it is being proposed that this grant be separated into two parts due to Kai Hwang's change of position to the University of Southern California. The activities include (1) The completion and submission for publication of one technical paper on expert systems for partial differential equations, (2) The completion of one report on high level parallel languages for multiprocessors, (3) One manuscript to be presented at a conference in October 1985, (4) Three manuscripts in progress on the use of supercomputers, the use of distributed multiprocessor systems for PDEs and new numerical methods, (5) Considerable process in the analysis and high-level restructuring of several important PDE algorithms for parallel execution. Independently of this grant, the investigators have just obtained a multiprocessor machine (the FLEX 32) which will greatly enhance the research program.

20570 (AD-A—185616/0/XAB) Air Force scientific report for AFOSR Grant AFOSR-85-0252. Final report, 15 June 1985-14 October 1986. Chandy, K.M.; Misra, J. (Texas Univ., Austin (USA). Dept. of Computer Sciences). 24 Mar 1987. 14p. NTIS, PC A03/MF A01.

This work has concentrated on developing a unifying framework, under the name UNITY, for studying problem solving in parallel programming independent of specific architectural considerations. The authors have proposed a simple model of computation and a logic to reason about properties of such programs and have managed to study problems from a variety of problem areas. They have developed a number of transformations appropriate for implementations on a variety of architectures: sequential, asynchronous shared memory, distributed message passing, synchronous parallel with shared memory, systolic arrays, and VLSI chips. The diversity of the application areas and the architectures studied lends credence to the hypothesis that there is a UNITY to programming.

20571 (AD-A—185746/5/XAB) Computer decision-making process for the elimination of noise from data. Environmental research papers. Berthel, R.O. (Air Force Geophysics Lab., Hanscom AFB, MA (USA)). 27 Mar 1987. 26p. (AFGL-TR—87-0118). NTIS, PC A03/MF A01.

Data acquired in many scientific and engineering activities are contaminated by noise or extraneous readings that are superimposed on base-line values. Automated data-analysis routines normally resort to some form of numerical averaging to suppress noise with the assumption that the smoothed values will closely approximate the base data. There are, however, circumstances where averaging may not produce acceptable results such as in situations of serve noise that are biased in magnitude and polarity. The Air Force Geophysics Laboratory was faced with this problem in the analysis of snow weight/rate data because of wind-acceptable error boundaries. It was then noted that the base values could be very closely replicated by a hand-drawn, best-guess line on the plotted, noisy-raw data. This revelation prompted the development of a computer process that, by mimicking the logic of human reasoning, can eliminate extraneous readings and reconstruct the base-line data to a very close approximation. As such, this computer decision-making procedure may be classified as a form of artificial intelligence that may be applicable to other analytical routines. This report discusses the problems associated with extraneous or noisy data and describes the technique that was developed to eliminate superfluous readings from snow weight/rate measurements.

20572 (AD-A—185766/3/XAB) Fast algorithms for structural optimization and least squares. Annual interim report, 15 July 1986-14 July 1987. Plemmons, R.J. (North Carolina State Univ., Raleigh (USA)). 7 Aug 1987. 11p. NTIS, PC A03/MF A01.

This report summarizes the activities in support of the Air Force Research Project AFOSR-83-0255 during the past year. Efforts have been made to develop, test, and analyze new fast techniques in matrix analysis for structural computations and least squares problems. Applications of this work include structural design and dynamics, and least squares filtering in signal processing. Implementations and tests have been made on modern high-performance architectures such as the Cray X-MP, Alliant FX/8, Sequent Balance, and the Intel iPSC Hypercube. Recent work on parallel algorithms for near real-time signal-processing computations has led to especially significant results.

20573 (AD-A—185842/2/XAB) Parallel algorithms for computer vision on the Connection Machine. Memorandum report. Little, J.J. (Massachusetts Inst. of Tech., Cambridge (USA). Artificial Intelligence Lab.). Nov 1986. 30p. (AI-M—928). NTIS, PC A03/MF A01.

The Connection Machine is a fine-grained parallel computer having up to 64K processors. It supports both local communication among the processors, which are situated in a two-dimensional mesh, and high-bandwidth communication among processors at arbitrary locations, using a message-passing network. Solutions to a set of image-understanding problems for the Connection Machine are presented. These problems were proposed by DARPA to evaluate architectures for image-understanding systems, and are intended to comprise a representative sample of fundamental procedures to be used in image-understanding. The solutions on the Connection Machine embody general methods for filtering images, determining connectivity among image elements, determining spatial relations of image elements and computing-graph properties, such as matchings and shortest paths.

20574 (AD-A—186051/9/XAB) Parallel Cholesky factorization on a shared-memory multiprocessor. Final report, 1 October 1986-30 September 1987. George, A.; Heath, M.T.; Liu, J. (Oak Ridge National Lab., TN (USA)). 1986. 24p. NTIS, PC A03/MF A01.

Pub. in Linear Algebra and Its Applications, Vol. 77, 165-187(1986).

A parallel algorithm is developed for Cholesky factorization on a shared-memory multiprocessor. The algorithm is based on self-scheduling of a pool of tasks. The subtasks in several variants of the basic elimination algorithm are analyzed for potential concurrency in terms of precedence relations, work profiles, and processor utilization. This analysis is supported by simulation results. The most promising variant, which the authors call column-Cholesky, is identified and implemented for the Denelcor HEP multiprocessor. Experimental results are given for this machine.

20575 (AD-A—186122/8/XAB) Parallel-block iterative scheme applied to computations in structural analysis. Plemmons, R.J. (North Carolina State Univ., Raleigh (USA)). Jul 1986. 12p. NTIS, PC A03/MF A01.

Pub. in SIAM Jnl. on Algebraic and Discrete Methods, Vol. 7, No. 3, 337-347(Jul 1986).

In this paper it is shown how a block cyclic successive over-relaxation direct-iterative method can be applied to the parallel solution of certain large-scale linear equality-constrained quadratic programming problems. The scheme is similar in nature to those studied recently by de Pillis, Niethammer and Varga and by Markham, Neumann and Plemmons for solving large sparse least squares problems, It is based upon a partitioning strategy of the fundamental matrix into a block consistently ordered 2-cyclic form where the nonzero and eigenvalues of the Jacobi matrix are all pure imaginary. The method is shown to be globally convergence and convergence rates are established. Applications of the algorithms are discussed for large-scale structural-analysis computations where it is shown how the algorithm can be adapted to the simultaneous computation of the system forces and the nodal displacements. Here, advantage can be taken of the special forms of the matrix involved. In particular, it is shown that much of the algorithm lends itself to efficient implementation of pipelined vector machines and on multiprocessors.

20576 (AD-A—186204/4/XAB) Signal-processing applications of some moment problems. Kailath, T. (Stanford Univ., CA (USA). Dept. of Electrical Engineering). Jan 1987. 41p. NTIS, PC A03/MF A01.

Pub. in Moments in Mathematics, 1-40(Jan 1987).

This document presents some applications where results from moment problems have been useful in various ways, e.g., in suggesting new algorithms better suited to parallel computation and new structures better suited to integrated-circuit realization. The author also describes how these applications have led to the need to go beyond some of the traditional confines of the moment problem, especially by imbedding the study of Toeplitz moment in those of a larger class of matrices with what has been called displacement structure.

20577 (AD-A—186300/0/XAB) Parallel logic programming and ZMOB and parallel systems software and hardware. Final report. Minker, J.; Weiser, M. (Maryland Univ., College Park (USA). Dept. of Computer Science). Dec 1986. 17p. NTIS, PC A03/MF A01.

Under the current grant, parallel hardware and systems software implemented on ZMOB in the previous year underwent extensive testing. A parallel problem-solving system, PRISM (Parallel Inference System) implemented on the VAX/11-780 in the previous year was implemented on the PYRAMID and SUN machines. The initial version of PRISM uses a simulation of the ZMOB hardware, and was fully tested and debugged. Experimental testing of PRISM on the simulated system was undertaken in the current year. In addition, several enhancements were made to PRISM to permit experimental analyses to be made, and to incorporate additional features to take full advantage of parallelism in a problem-solving environment. The tracing and statistical gathering packages were extended. An AND-parallelism capability was added to achieve a second version of the PRISM system, and other features were added to the system to more fully exploit parallelism. A constraint solving machine was integrated with PRISM. In addition to the above, a general method to permit informative answers to be presented to a user was developed. Theoretical results were obtained for circumscription and a method for computing in protected circumscription, using Horn clauses, was developed. In the area of systems hardware and software, the ZMOB processor is now fully functional and in everyday use with 128 processors.

20578 (AEEW-R—2078) Status report on the group data version of MONK5W. Hutton, J.L.; Robichaud, K. (UKAEA Atomic Energy Establishment, Winfrith). May 1986. 58p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88750918/JAW.

MONK is a well established calculational tool for solving neutronics problems. Recent developments and changes have included its transfer to other computers such as CRAY and SUN, its use on microcomputers, the listing of data input specification which can be displayed by the user on a VDU or listed on a printer, and the use of colour graphics. These changes are described with their effect on the input data. (U.K.).

20579 (BDX—613-3830) CABPRO: A rule-based expert system for process planning of assembled multiwire cables. Schaefer, R.M.; Colmer, J.S.; Miley, M. (Allied-Signal, Inc., Kansas City, MO (USA). Bendix Kansas City Div.). Dec 1987. Contract AC04-76DP00613. 15p. (CONF-880315—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003819/JAW.

From 4. IEEE conference on artificial intelligence applications; San Diego, CA, USA (14 Mar 1988).

Process planning for the manufacture of multiwire cables is a labor-intensive activity, often based on engineering experience and rules of thumb. Rather than the traditional form of expert system programming, which follows decision trees to a preplanned answer, this activity requires the system to produce an original plan based solely on the design requirements of the cable. CABPRO is a prototype system which produces the assembly instructions of a

multiwire cable with a subset of features associated with it. CABPRO has proven to produce work instructions equivalent to those chosen by process engineers for the same cables in a fraction of the time. These results show promise that the CABPRO prototype will provide a solid foundation for the production version.

20580 **(CONF-880327—1) A menu-driven knowledge retrieval system accessing ASCII data.** Clapp, N.E. Jr.; Renshaw, A.W.; Snyder, C.E. (Oak Ridge National Lab., TN (USA)). Aug 1987. Contract AC05-84OR21400. 13p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88001742/JAW.

From Conference on user-oriented content-based text and image handling; Cambridge, MA, USA (21 Mar 1988).

The knowledge retrieval system reported here consists of two elements: a utility program and a data set containing the knowledge base. The utility program provides the capability of retrieving and displaying information using layered menus. The layered menu system is similar to a logical tree structure, with each menu being a major node of the tree. The system is designed to be data driven, which allows it to be maintained, refined, and expanded by modifying the data set.

20581 **(CONF-8605160—1-FP) Solving scientific problems on hypercube parallel computers.** Ward, R.C. (Oak Ridge National Lab., TN (USA)). 1986. Contract AC05-84OR21400. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88002614/JAW.

From Supercomputing decision for scientific computing conference; Fairfax, VA, USA (15 May 1986).

This paper discusses the need of a hypercube parallel computer (or supercomputer) in solving new scientific problems. Performance and efficiency are discussed along with certain applications. 4 refs. (LSP)

20582 **(CONF-8708148—2) Programming methodology and performance issues for advanced computer architectures.** Dongarra, J.J.; Sorensen, D.C.; Connolly, K.; Patterson, J. (Argonne National Lab., IL (USA)). 1987. Contract W-31109-ENG-38. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003098/JAW.

From Vector and parallel processing in computational science; Liverpool, UK (25 Aug 1987).

This paper will describe some recent attempts to construct transportable numerical software for high performance computers. Restructuring algorithms in terms of simple linear algebra modules is reviewed. This technique has proved very successful in obtaining a high level of transportability without severe loss of performance on a wide variety of both vector and parallel computers. The use of modules to encapsulate parallelism and reduce the ratio of data movement to floating point operations has been demonstrably effective for regular problems such as those found in dense linear algebra. In other situations it may be necessary to express explicitly parallel algorithms. We also present a programming methodology that is useful for constructing new parallel algorithms which require sophisticated synchronization at a large grain level. We describe the SCHEDULE package which provides an environment for developing and analyzing explicitly parallel programs in Fortran which aare portable. This package now includes a preprocessor to achieve complete portability of user level code and also a graphics post processor for performance analysis and debugging. We discuss details of porting both the SCHEDULE package and user code. Examples from linear algebra, and partial differential equations are used to illustrate the utility of this approach.

20583 **(DOE/ER/25001—41) Data prefetching in shared memory multiprocessors.** Lee, R.L.; Yew, Pen-Chung; Lawrie, D.H. (Illinois Univ., Urbana (USA). Center for Supercomputing Research and Development). 1987. Contract FG02-85ER25001. 5p. (CONF-870831—15). NTIS, PC A02. Order Number DE88003576/JAW.

From International conference on parallel processing; St. Charles, IL, USA (17 Aug 1987).

The trace driven simulation of 16 numerical subroutines is used to compare instruction lookahead and data prefetching with private caches in shared memory multiprocessors with hundreds or thousands of processors and memory modules interconnected with a pipelined network. These multiprocessors are characterized by long memory access delays that create a memory access bottleneck. Using the multiprocessor cache model for comparison, data prefetching is found to be more effective than caches in addressing the memory access bottleneck. 5 refs., 6 figs.

20584 **(DOE/ER/25001—52) A multiprocessor scheme for the singular value decomposition.** Berry, M.; Sameh, A. (Illinois Univ., Urbana (USA). Center for Supercomputing Research and Development). Aug 1987. Contract FG02-85ER25001. 10p. (CONF-871251—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003591/JAW.

From 3. SIAM conference on parallel processing for scientific computing; Los Angeles, CA, USA (1 Dec 1987).

We present a multiprocessor scheme for determining the singular value decomposition of rectangular matrices in which the number of rows is substantially large (or smaller) than the number of columns. In this scheme, we perform an initial QR factorization on the tall matrix (either A or A/sup T/) using a multiprocessor block Householder algorithm. We then use a parallel one-sided Jacobi scheme to orthogonalize the columns of the upper triangular matrix R to yield the factorization $RV = U\Sigma$, from which the desired singular value decomposition is obtained. Preliminary experiments on an Alliant FX/8 computer system with 8 processors indicate speedups near 5 for our scheme over an optimized implementation of the Linpack/Eispack routines which perform the classical bi-diagonalization technique. Our scheme performs exceptionally well for rank deficient matrices as well as for those rectangular matrices having clustered or multiple singular values, and may be well suited for applications such as real-time signal processing. We present performance results on the Alliant FX/8 and Cray X-MP/48 computer systems with particular emphasis on speedups obtained for our scheme over classical SVD algorithms.

20585 **(DOE/ER/25001—55) Parallel algorithms on the CEDAR system.** Berry, M.; Gallivan, K.; Harrod, W.; Jalby, W.; Lo, Sy-Shin; Meier, U.; Philippe, B.; Sameh, A. (Illinois Univ., Urbana (USA). Center for Supercomputing Research and Development). 21 Oct 1986. Contract FG02-85ER25001. 28p. (CSRD—581; CONF-8609378—1). Univ. of Illinois, 305 Talbot, 104 South Wright St., Urbana, IL 61801-2932. Order Number TI88003531/JAW.

From CONPAR '86; Aachen, F.R. Germany (17 Sep 1986).

While significant progress has been made in developing efficient algorithms for vector machines, the same cannot be said of parallel processors which provide concurrency and vectorization along with a complex memory system. The three aspects of these architectures must be addressed simultaneously and are often contradictory; increasing vector length may destroy data locality and thereby lead to inefficient use of the hierarchical memory system. In this paper, we consider the tradeoffs involved in designing algorithms for such architectures and present some results for a single cluster of the CEDAR machine. 22 refs., 14 figs.

20586 **(DOE/ER/25001—56) Algorithms and experiments for structural mechanics of high performance architectures.** Berry, M.W.; Plemmons, R.J. (Illinois Univ., Urbana (USA). Center for Supercomputing Research and Development). Sep 1986. Contract FG02-85ER25001. 33p. (CONF-8609377—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003578/JAW.

From 1. world congress on computational mechanics; Austin, TX, USA (22 Sep 1986).

Given a finite element model of a structure and a set of external loads, one of the primary objectives of elastic analysis and structural dynamics is to determine the internal forces, leading to the resulting stresses, strains and displacements. Considering the increasing demands upon the structural engineer to analyze larger and more complex structures, the need for multiprocessing and/or vectorization of the numerical schemes being used is substantial if time-to-solution reductions are desired. The simplest approach to structural mechanics computations is the formation and Cholesky factorization of the global stiffness matrix K. On the other hand, inherent ill-conditioning in K often requires extended precision computations. As a result, alternatives to the formation of K such as orthogonal factorization and preconditioned conjugate gradient

techniques have gained in popularity. Presented here is a detailed study of the performance of some promising alternative algorithms to the stiffness equations approach on high performance architectures. Implementations of direct and iterative methods for the solution of structural mechanics problems have been made on the Alliant FX/8 and Cray X-MP systems. The direct methods include the classical Cholesky factorization of the stiffness matrices, the natural factor method of Argyris and a weighted least squares with iterative improvement method of Van Loan. The iterative methods include new preconditioned conjugate gradient methods for weighted least squares problems by Freund and for least squares with equality constraints by Barlow, Nichols, and Plemmons.

20587 **(DOE/ER/25001—57) Architecture of the Cedar parallel supercomputer.** Yew, Pen-Chung. (Illinois Univ., Urbana (USA). Center for Supercomputing Research and Development). Aug 1986. Contract FG02-85ER25001. 14p. (CONF-8608119—2; CSRD—609). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003600/JAW.

From IBM institute-Europe; Lech, Austria (8 Aug 1986).

Limitations in vector processing and in device speed have led to the development of parallel supercomputer systems. The Cedar parallel supercomputer system currently being designed and developed at the University of Illinois at Urbana-Champaign is an effort to provide high system performance through parallel processing. Its system organization and key architectural features are briefly described here.

20588 **(DOE/ER/25001—58) On the design of parallel numerical methods in message passing and shared memory environments.** Saad, Y. (Illinois Univ., Urbana (USA). Center for Supercomputing Research and Development). Feb 1987. Contract FG02-85ER25001. 24p. (CONF-870294—2; CSRD—614). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003566/JAW.

From International seminar on scientific supercomputers; Paris, France (2 Feb 1987).

This paper presents a comparative view of the methodologies used in parallel methods for scientific computing. Our goal is to put in contrast the approaches taken when developing scientific software for two broad classes of parallel machines namely shared memory machines and distributed memory machines. We will illustrate our discussion with two specific algorithms namely the Alternating Directions Implicit method and the Preconditioned Conjugate Gradient method.

20589 **(DOE/ER/25001—60) Parallel garbage collection on a virtual memory system.** Abraham, S.G.; Patel, J.H. (Illinois Univ., Urbana (USA). Center for Supercomputing Research and Development). 1987. Contract FG02-85ER25001. 26p. (CONF-8706138—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003567/JAW.

From 14. annual international symposium on computer architecture; Pittsburgh, PA, USA (2 Jun 1987).

Since most artificial intelligence applications are programmed in list processing languages, it is important to design architectures to support efficient garbage collection. This paper presents an architecture and an associated algorithm for parallel garbage collection on a virtual memory system. All the previously proposed parallel algorithms attempt to collect cells released by the list processor during the garbage collection cycle. We do not attempt to collect such cells. As a consequence, the list processor incurs little overhead in the proposed scheme, since it need not synchronize with the collector. Most parallel algorithms are designed for shared memory machines which have certain implicit synchronization functions on variable access. The proposed algorithm is designed for virtual memory systems where both the list processor and the garbage collector have private memories. The enforcement of coherence between the two private memories can be expensive and is not necessary in our scheme. 15 refs., 3 figs.

20590 **(DOE/ER/25001—66) Instrumentation for the development of parallel programs.** Guarna, V.; Malony, A. (Illinois Univ., Urbana (USA). Center for Supercomputing Research and Development). Jan 1987. Contract FG02-85ER25001. 4p. (CSRD—638; CONF-8701109—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003577/JAW.

From IEEE/ACM sigarch workshop on instrumentation for distributed computing systems; Sanibel Island, FL, USA (22 Jan 1987).

Consider a parallel program composed of multiple tasks. These tasks execute independently except when they must synchronize to satisfy dependencies that exist in the program. The problem of instrumenting a multiple processor system for developing parallel programs is the need to identify, monitor and measure the activities of every program task, and to correlate this data with all program tasks. This need is present in all stages of the parallel program development cycle from debugging to performance analysis to optimization. This paper discusses the critical instrumentation issues for the development of parallel programs in the areas of performance analysis and debugging.

20591 **(DOE/ER/25001—70) Parallel discrete event simulation: A shared memory approach.** Reed, D.A.; Malony, A.D.; McCredie, B.D. (Illinois Univ., Urbana (USA). Dept. of Computer Science; Illinois Univ., Urbana (USA). Center for Supercomputing Research and Development; Illinois Univ., Urbana (USA). Dept. of Electrical and Computer Engineering). 1987. Contract FG02-85ER25001. 32p. (CONF-8705243—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003582/JAW.

From ACM sigmetrics conference on measurement and modeling of computer systems; Banff, Canada (1 May 1987).

Distributed simulation has been the subject of several simulated performance studies; little or no experimental data have heretofore been available. Obtaining such data was the primary goal of this work. Using queueing networks as the simulation application, we simulated a variety of such networks with varying workloads using several variations of the Chandy-Misra algorithm on a shared memory machine. These experiments show that, with rare exception, the Chandy-Misra approach to distributed simulation is not a viable approach to parallel simulation of queueing network models. There are two primary reasons for this. First, a single processor implementation of the Chandy-Misra algorithm is sometimes slower than the equivalent sequential, event-driven simulation. Thus, multiple processors are needed just to recoup the loss due to the inefficiency. Second, networks with cycles require deadlock avoidance or recovery techniques. These techniques are extremely costly, and there is little prospect that they can be reduced to acceptable levels.

20592 **(DOE/ER/25001—75) Automatic restructuring of Fortran programs for parallel execution.** Polychronopoulos, C. (Illinois Univ., Urbana (USA). Center for Supercomputing Research and Development). May 1987. Contract FG02-85ER25001. 27p. (CONF-8706181—2; CSRD—665). NTIS, PC A03/MF A01; GPO Dep. Order Number DE88003585/JAW.

From 4. Deutsche Forschungs-und Verschesanstalt Fur Fult- und Raumfahart conference; Koln, F.R. Germany (25 Jun 1987).

With the widespread of high performance parallel processor computers, the need for powerful restructuring compilers an software environments for program development has become more pressing than ever before. In this paper we discuss the usefulness of automatic program restructuring, and present some well-known and some new program transformations that can be used to extract parallelism out of serial Fortran programs. Additional functions that could be carried out by a compiler are also discussed.

20593 **(DOE/ER/25001—78) Fast Poisson solver on irregular regions by boundary integral-based domain decomposition methods.** Lee, D.; Gallopoulos, E. (Illinois Univ., Urbana (USA). Center for Supercomputing Research and Development). Jul 1987. Contract FG02-85ER25001. 5p. (CONF-871251—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003583/JAW.

From 3. SIAM conference on parallel processing for scientific computing; Los Angeles, CA, USA (1 Dec 1987).

A method for a fast solution of the Poisson equation on irregular regions is proposed. The method, which may be called the Boundary Integral-based Domain Decomposition (BIDD) method, seems to be particularly efficient for parallel processing of large scale boundary value problems. For instance, in a hierachical multiprocessor system like the Cedar architecture, each cluster and each processor of a cluster can solve an independent subproblem resulting from the BIDD approach. 13 refs.

20594 **(DOE/ER/25009—493) The physical structure of concurrent problems and concurrent computers.** Fox, G.C.; Furmanski, W. (California Inst. of Tech., Pasadena (USA)). 1988. Contract AC04-76DP00789;FG03-85ER25009. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005812/JAW.

We introduce a physical analogy to describe problems and high performance concurrent computers on which they are run. We show that the spatial characteristics of problems lead to their parallelism and review the lessons from use of the early hypercubes and a natural particle-process analogy. We generalize this picture to include the temporal structure of problems and show how this allows us to unify distributed, shared, and hierarchical memories as well as SIMD architectures. We also show how neural network methods can be used to analyze a general formalism based on interacting strings and these lead to possible real-time schedulers and decomposers for massively parallel machines. 57 refs., 21 figs.

20595 **(DOE/ER/25009—496) A portable programming environment for multiprocessors.** Fox, G.C.; Walker, D.W. (California Inst. of Tech., Pasadena (USA)). 1988. Contract FG03-85ER25009. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005814/JAW.

This paper discusses the issues involved in designing a portable programming environment for large grain-size MIMD concurrent processors. In addition, a detailed description of such an environment is given, and its implementation on the distributed memory Mark IIIfp hypercube and the shared memory ETA-10 is outlined. 5 refs.

20596 **(DOE/ER/25009—502) DIME [Distributed Irregular Mesh Environment]: A programming environment for unstructured triangular meshes on a distributed-memory parallel processor.** Williams, R.D. (California Inst. of Tech., Pasadena (USA)). 1987. Contract FG03-85ER25009. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005815/JAW.

DIME (Distributed Irregular Mesh Environment) is a user environment written in C for manipulation of an unstructured triangular mesh in two dimensions. The mesh is distributed among the separate memories of the processors, and communication between processors is handled by DIME; thus the user writes C-code referring to the elements and nodes of the mesh and need not be unduly concerned with the parallelism. A tool is provided for the user to make an initial coarse triangulation of a region, which may then be adaptively refined and load-balanced. DIME provides many graphics facilities for examining the mesh, including contouring and a Postscript hard-copy interface. DIME also runs on sequential machines. 8 refs., 18 figs.

20597 **(DOE/ER/25026—8-12/87) Polynomial preconditioning for conjugate gradient methods.** Ashby, S.F. (Illinois Univ., Urbana (USA). Dept. of Computer Science). Dec 1987. Contract FG02-87ER25026. 137p. (UIUCDCS-R—87-1355). NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88005214/JAW.

The solution of a linear system of equations, $Ax = b$, arises in many scientific applications. If A is large and sparse, an iterative method is required. When A is hermitian positive definite (hpd), the conjugate gradient method of Hestenes and Stiefel is popular. When A is hermitian indefinite (hid), the conjugate residual method may be used. If A is ill-conditioned, these methods may converge slowly, in which case a preconditioner is needed. In this thesis we examine the use of polynomial preconditioning in CG methods for both hermitian positive definite and indefinite matrices. Such preconditioners are easy to employ and well-suited to vector and/or parallel architectures. We first show that any CG method is characterized by three matrices: an hpd inner product matrix B, a preconditioning matrix C, and the hermitian matrix A. The resulting method, CG(B,C,A), minimizes the B-norm of the error over a Krylov subspace. We next exploit the versatility of polynomial preconditioners to design several new CG methods. To obtain an optimum preconditioner, we solve a constrained minimax approximation problem. The preconditioning polynomial, $C(\lambda)$, is optimum in that it minimizes a bound on the condition number of the preconditioned matrix, p/sub m/(A). An adaptive procedure for dynamically determining the optimum preconditioner is also discussed. Finally, in a variety of numerical experiments, conducted on a Cray X-MP/48, we demonstrate the effectiveness of polynomial preconditioning. 66 ref., 19 figs., 39 tabs.

20598 **(EGG-M—33486) Artificial intelligence applied to process signal analysis.** Corsberg, D. (EG and G Idaho, Inc., Idaho Falls (USA)). 1986. Contract AC07-76ID01570. 6p. (CONF-8611219—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005552/JAW.

From Artificial intelligence for space applications; Huntsville, AL, USA (13 Nov 1986).

Many space station processes are highly complex systems subject to sudden, major transients. In any complex process control system, a critical aspect of the human/machine interface is the analysis and display of process information. Human operators can be overwhelmed by large clusters of alarms that inhibit their ability to diagnose and respond to a disturbance. Using artificial intelligence techniques and a knowledge-based appraoch to this problem, the power of the computer can be used to filter and analyze plant sensor data. This will provide operators with a better description of the process state. Once a process state is recognized, automatic action could be initiated and proper system response monitored. 8 refs.

20599 **(EGG-M—40187) Quality enhancement with machine intelligence.** Johnson, M.R. (EG and G Idaho, Inc., Idaho Falls (USA)). 1988. Contract AC07-76ID01570. 9p. (CONF-880345—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005639/JAW.

From International symposium on computer-aided quality assurance; Leipzig, German D.R. (17 Mar 1988).

This paper discussed applications of machine intelligence for quality enhancement in several areas of technology including signal verification and validation, control systems, fault tolerance, artificial intelligence, and medical research. The purpose of this general presentation is to set the stage for the more detailed ideas that will follow in the symposium, and to encourage participants to broaden their views, definitions, and thinking in regard to quality. 13 refs.

20600 **(EPRI-NP—5525) Robotic task planning: Domain modeling and geometric reasoning: Final report.** Oppenheim, I.J.; Rehak, D.R.; Keirouz, W.T.; Woodbury, R.F. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Civil Engineering). Dec 1987. 140p. Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number TI88920129/JAW.

Robot systems for construction and maintenance will require computer representations of the nuclear power plant environment specifically suited to robot control and task planning; two research efforts in representation are reported, one on domain modeling and one on geometric reasoning. The domain modeling approach is based on a multi-layered network representation. It demonstrates the ability to model the domain at different levels of abstraction, from a coarse map for path planning down to a detailed description for component assembly. The overall domain model is actually a set of nested models at any level of emphasis chosen by the developer. The approach is developed in an object-oriented programming environment, which is particularly effective in software development. A proposed geometric reasoning approach, also based in an object-oriented programming language, produces a declarative formulation for the representation and manipulation of geometric information. It permits the treatment of geometric knowledge in a knowledge-based expert system, using high-level concepts as employed by humans. The architecture for geometric reasoning uses

spatial sets, an abstraction hierarchy, the concept of features, and the propagation of constraints to accomplish ths knowledge representation. 10 refs., 10 figs.

20601 (LA—11198-MS) Vector performance of register-to-register vector computers. Bucher, I.Y. (Los Alamos National Lab., NM (USA)). Jan 1988. Contract W-7405-ENG-36. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004013/JAW.

Advances in compiler technology have changed the vector performance characteristics of register-to-register vector computers. The paper compares measurements under carefully controlled conditions on a single processor of the CRAY X-MP with existing performance models. Vector startup times are context dependent and can be negative. Memory access contentions lead to significant performance degradations even with a single processor. Our simulation studies reproduce the measured results and point to possible improvements. A new performance model is introduced that adequately represents vector performance of present register-to-register vector computers. 9 refs., 21 figs.

20602 (LA—11204-MS) Supercomputer performance: The theory, practice, and results. Lubeck, O.M.; Shapar, E.A. (ed.). (Los Alamos National Lab., NM (USA)). Jan 1988. Contract W-7405-ENG-36. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88004697/JAW.

The National Research Council, in a recent report on supercomputer performance, has noted that supercomputer performance measurements fall in a hierarchy of measurement tests. The hierarchy spans benchmarks ranging from low-dimensional demonstration loops to highly integrated full application codes. This paper surveys recent performance measurements of supercomputers from numerous sources in the framework of this hierarchy. A critical evaluation of specific benchmark practices is presented, and the possible reasons for misinterpretation of benchmark results is discussed. The current state of vectorized workloads is also surveyed and the future of vectorization in supercomputer architectures is considered. 51 refs., 8 figs., 31 tabs.

20603 (LA-UR—87-1270) Dynamic run-time graphics. Tabor, J. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 16p. (CONF-8704165—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87008997/JAW.

From Cray User Group spring meeting; New York City, NY, USA (21 Apr 1987).

The major components of the Instant Graphics Package (IGP) have been integrated with the Dynamic Debugging Tool (DDT). IGP and DDT can produce 1D, 2D, and 3D plots; 2D contour plots; and array-versus-array plots at run time for a CTSS controllee memory image. These plots can be used to graphically inspect any array and to satisfy many of the user community's routine graphics requirements. A brief overview of the USERPORT feature, which can dynamically interface to any fragment of a CTSS controllee, will be presented. 7 refs., 17 figs.

20604 (N—88-11398) Cache-based error recovery for shared memory multiprocessor system. Wu, K.L.; Fuchs, W.K.; Patel, J.H. (Illinois Univ., Urbana (USA)). Nov 1987. 21p. (NASA-CR—181470; NAS—1.26:181470; CONF-8706255—). NTIS, PC A03/MF A01.

From FTCS 18 conference; Tokyo, Japan (27 Jun 1987).

The problem of recovering from processor failures in shared memory multiprocessor systems is examined. A cache-based checkpointing scheme is developed utilizing a checkpointing algorithm which guarantees that a consistent global state is always maintained. Processes can recover from errors due to a faulty processor by restarting from the consistent saved computation state. There are no difficulties with checkpoint propagation in that when a process p takes a checkpoint, no other process is forced to join p in the checkpoint. The recovery algorithm allows only those processes encountering errors to perform rollback recovery while other unaffected processes on fault free processors continue normal execution. The checkpointing recovery schemes are shown to be easily integrated into standard bus-based cache coherence protocols. An analytical model is used to estimate the checkpointing frequency and the performance degradation incurred by the checkpointing scheme during normal execution.

20605 (ORNL/CSD/TM—257) Cray summaries manual. (Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 234p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE88006134/JAW.

Summary descriptions of forty-nine CTSS routines are presented in this document, which is intended as a quick reference guide for users of CTSS at Martin Marietta Energy Systems, Inc. in Oak Ridge. Some of the information included is site-specific.

20606 (PB—88-118690/XAB) Machine models and simulations. van Emde Boas, P. (Amsterdam Univ. (Netherlands). Dept. of Computer Science). 1987. 66p. (FVI—87-01). NTIS, PC E04/MF A01.

In Complexity Theory, the use of informal estimates can be justified by appealing to the Invariance Thesis which states that all standard models of sequential computing devices are equivalent in the sense that the fundamental complexity classes don't depend on the precise model chosen for their definition. Similarly, the Parallel Computation Thesis states that parallel models have polynomially related time measures and that, moreover, parallel time is polynomially equivalent to sequential space. The author gives a survey on the world of machine models and the simulations between them. The sequential models satisfying the invariance thesis are gathered into a First Machine Class and the parallel models which satisfy the Parallel-Computation thesis into a Second Machine Class. This seems not to exhaust all machine models proposed in the literature, not even all models introduced as being reasonable. The survey takes us from the weakest universal models considered by mathematicians (like Minsky's two-counter machine) to the most powerful parallel models considered today where time ceases to be a complexity measure.

20607 (PB—88-126297/XAB) Solution methods for bidiagonal and tridiagonal linear systems for parallel and vector computers. Michielse, P.H. (Technische Hogeschool Delft (Netherlands). Onderafdeling der Wiskunde en Informatica). 1987. 29p. (REPT—87-04). NTIS, PC E03/MF A01.

The authors examine the recursive doubling method for bidiagonal linear systems by which the complete solution process for $Ax = b$, where A is a bidiagonal matrix, can be carried out in several parallel parts. Furthermore, Wang's partition method is applied to these bidiagonal systems, and a completely parallel method for tridiagonal systems is studied. These latter methods are shown to offer an advantage over the recursive doubling method. Vector aspects of the algorithms mentioned are discussed, too.

20608 (PB—88-127279/XAB) Flexible fault tolerance with n-cube network. Andriessen, J.H.M. (Technische Hogeschool Delft (Netherlands). Onderafdeling der Wiskunde en Informatica). 1987. 15p. (REPT—87-28). NTIS, PC E03/MF A01.

For Multiple Instruction, Multiple Data stream (MIMD) supercomputers with a general-purpose interconnection network, a method is proposed to implement a fault-tolerant computing mode by programming the system. First, the interconnection network is discussed. Next, fault tolerance and reliability of the network are considered for non-self-checking processing elements. The proposed fault-tolerance method uses several safety nets, to assure a high save-drop-out ratio, by Hybrid, Triple and Duplex Redundancy.

20609 (PB—88-129242/XAB) Parallel repeat solution solver for sparse matrices. Enns, M.K.; Alvarado, F.; MacGregor, D.M. (Electrocon International, Inc., Ann Arbor, MI (USA)). 1985. 85p. NTIS, PC A05/MF A01.

This research successfully examines the repeat solution phase of the solution of the linear system $A x = b$, for a sparse matrix A and a vector b. A new algorithm uses the partitioned inverses of the conventional lower and upper triangular factors of A. Solutions are obtained by direct matrix-vector multiplication of those factors by the vector b. Examples from power system analysis, structural analysis, and finite-element methods have been used to determine the effectiveness of ordering and partitioning in forming these fac-

tors. Although not as sparse as the traditional LU factors, these partitioned inverse factors are sufficiently sparse (0.5 to 2%) to make their use practical. Large cases require about 50% more arithmetic operations in comparison with conventional forward elimination and back substitution. However, these operations can now be done in parallel, making a significant speedup possible. Two hypothetical hardware designs were simulated to show the expected speedup from parallel processing.

20610 **(PB—88-854328/XAB) Vector processing and processors. January 1975-December 1987 (citations from the NTIS data base). Report for January 1975-December 1987.** (National Technical Information Service, Springfield, VA (USA)). Dec 1987. 45p. NTIS PC N01/MF N01.

This bibliography contains citations concerning development and evaluation of high speed and high-performance vector processing and processors. Topics include computer architecture, vector computers, vector algorithms, Monte Carlo techniques, and Cray-1 processors. Applications in high-speed scientific computations, vectorization of nuclear codes, and aerodynamic flow analysis are discussed. (Contains 88 citations fully indexed and including a title list.)

20611 **(SAND—87-0652) MASPLT: A one-dimensional graphics post processor for wave propagation codes.** Rottler, J.S.; Thompson, S.L. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1987. Contract AC04-76DP00789. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005506/JAW.

MASPLT is a one-dimensional graphics post processor for wave propagation codes. MASPLT employs a simple database structure that allows the program to be adapted to process data generated by dissimilar wave propagation codes. This report provides a complete set of input instructions for MASPLT, as well as a description of the structure of the MASPLT database. The report also provides examples of the types of plotted output that can be generated using MASPLT.

20612 **(SAND—87-0653) HISPLT: A history graphics post processor for wave propagation codes.** Rottler, J.S.; Thompson, S.L. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1987. Contract AC04-76DP00789. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005507/JAW.

HISPLT is a history graphics post processor for wave propagation codes. HISPLT employs a database structure that allows the program to be used without modification to process data generated by any wave propagation code. This report provides a complete set of input instructions for HISPLT, as well as a description of the structure of the HISPLT database. The report also provides examples of the types of plotted output that can be generated using HISPLT.

20613 **(SAND—87-1337) SANDAC V to VME system interface user's guide.** Wilde, M.G. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1987. Contract AC04-76DP00789. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006221/JAW.

The SANDAC V Aerospace Guidance Computer is a high-speed, multiprocessor system designed for embedded applications. As such, design constraints have led to a highly miniaturized system with each processor module performing better than the VAX 11/780. The small size, however, limits the "standard" peripherals available for use with the SANDAC V. It was felt that an interface to a standard bus structured system, such as the VME system, would enable many tasks to be accomplished readily via a predefined interface as opposed to the need to implement special purpose interfaces for each application. A standard VME bus repeater card, the Performance Technologies, Inc. PT-VME901 VME (rev. 124-000301) bus repeater, was selected as the actual interface into the VME chassis. This document describes the modifications necessary to that card, along with the interface developed at Sandia National Laboratories for full functional capability.

20614 **(SAND—87-2018) CSQPLT: A graphics post processor for multidimensional wave propagation codes.** Rottler, J.S.; Thompson, S.L. (Sandia National Labs., Albuquerque, NM (USA)). Nov 1987. Contract AC04-76DP00789. 65p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005508/JAW.

CSQPLT is a graphics post processor for multidimensional wave propagation codes. CSQPLT employs a database structure that allows the program to be adapted to process data generated by dissimilar multidimensional wave propagation codes. This report provides a complete set of input instructions for CSQPLT, as well as a description of the structure of the CSQPLT database. The report also provides examples of the types of plotted output that can be generated using CSQPLT.

20615 **(SAND—87-2242C) A knowledge system for automatic finite element mesh generation: AMEKS.** Phillips, L.R.; Mitchiner, J.L.; Blacker, T.D. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 16p. (CONF-880315—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE87014894/JAW.

From 4. IEEE conference on artificial intelligence applications; San Diego, CA, USA (14 Mar 1988).

Finite element analysis is widely employed by the engineering community for the numerical analysis of complex structures. It involves the partitioning of an object into small elements for which applicable physical responses can be readily formulated. The generation of this partition, or mesh, is a tedious and often difficult part of the analysis. This paper presents a knowledge-based system, AMEKS, that, in conjunction with existing software, automatically meshes objects using the transfinite mapping technique. This technique requires tha analyst to decompose complex objects into primitive shapes and prepare each primitive for algorithmic meshing based on problem geometry and mesh requirements. AMEKS now performs these tasks. Several characteristics of this problem indicate the need for artificial intelligence techniques. Decomposition is non-algorithmic and expertise intensive. The number of possible decompositions is usually too large for exhaustive search. Locally acceptable decompositions can prove to be globally unacceptable. The concept of "primitive" is ill-defined, and once a region is classified as primitive, its acceptability for meshing is case-by-case dependent on geometry, physics and the available alternatives. AMEKS currently accepts two-dimensional straight-sided objects. It uses frames to represent the geometry, rules to classify regions and evaluate region quality, heuristic search control to prune the large search space, and assumption-based truth maintenance to simultaneously examine multiple contexts during the decomposition.

20616 **(SAND—87-8943) Starloc [Sandia TARget LOcation Computer]: A special-purpose computer architecture for target location within an image.** Napolitano, L.M. Jr.; Bryson, P.R.; Berry, K.R.; Klapp, S.R.; Leeper, J.E.; Redinbo, G.R. (Sandia National Labs., Livermore, CA (USA); California Univ., Davis (USA)). Jan 1988. Contract AC04-76DR00789. 15p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88005890/JAW.

Starloc (Sandia TARget LOcation Computer) is a special-purpose computer designed for target location in an image. It is now under development and when completed will process two 256 pixel by 256 pixel input images per second, recognizing targets within them regardless of target variations such as rotation, range, brightness, and angle of view. Starloc's basic architecture consists of ten pipelined processing stages (eight for Fast Fourier Transform operations and two for pixel by pixel operations) arranged in a ring-like structure. Within each stage are a controller, image memory, address generator, and register file with parallel floating-point processors. Starloc is designed to be fault tolerant by including two hot standby stages that can be switched into the data path when other stages fail and by incorporating a comprehensive set of error checkers. Using currently available 10 MFLOP (million floating-point operations per second) floating-point processors, Starloc will run at a sustained rate of 188 MFLOPS with 94% efficiency. At this rate, it is performing 36 complex 256 pixel by 256 pixel two-dimensional Fast Fourier Transforms per second. 5 refs., 7 figs.

20617 **(SOL—87-13) Constrained nonlinear programming.** Gill, P.E.; Murray, W.; Saunders, M.A.; Wright, M.H. (Stanford Univ., CA (USA). Systems Optimization Lab.). Dec 1987. Contract FG03-87ER25030. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005695/JAW.

We review several aspects of constrained nonlinear programming. Selected optimality conditions are derived and discussed. We also present various algorithms for constrained nonlinear programming, including their theoretical and practical properties. 51 refs.

20618 **(UCRL—92122-Rev.1) Data flow graph optimization in IF1.** Skedzielewski, S.K.; Welcome, M.L. (Lawrence Livermore National Lab., CA (USA)). 2 Dec 1987. Contract W-7405-ENG-48. 20p. (CONF-8509440—1-Rev.1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004396/JAW.

From 2. conference on functional programming and computer architectures; Nancy, France (16 Sep 1985).

Optimization techniques are as important when compiling data flow languages as when compiling conventional languages. This paper describes work that has been done on optimizers for SISAL programs that have been translated into IF1 data flow graphs. It shows that conventional optimization algorithms can be easily and efficiently implemented for data flow graphs, and that the payoff for even simple optimizations can be significant.

20619 **(UCRL—97914) The Cerberus multiprocessor simulator.** Brooks, E.D. III; Axelrod, T.S.; Darmohray, G.A. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 9p. (CONF-871251—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005424/JAW.

From 3. SIAM conference on parallel processing for scientific computing; Los Angeles, CA, USA (1 Dec 1987).

We describe a simulation facility for scalable shared memory multiprocessors. The processors are a RISC architecture with a minimum of additional instruction added to support synchronization. The functional units of the processors, including access to the shared memory, are fully pipelined. The multiprocessor is simulated at a very detailed level, with pipline delays and conflicts in the packet switched shared memory server being accurately accounted for. Applications are written in C. The simulator can be used to examine algorithm performance as the number of processors in the multiprocessor is scaled, providing results for machine sizes not currently available in real hardware.

20620 **(UCRL—97939) Gaussian techniques on shared memory multiprocessor computers.** Darmohray, G.A.; Brooks, E.D. III. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 9p. (CONF-871251—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005426/JAW.

From 3. SIAM conference on parallel processing for scientific computing; Los Angeles, CA, USA (1 Dec 1987).

We present performance results for parallel Gauss and Gauss-Jordan elimination algorithms on a shared memory multiprocessor. The Cerberus multiprocessor simulator, a simulator for a scalable shared memory multiprocessor with fully pipelined functional units, is used to evaluate algorithm performance. Our parallel implementations of these linear system solvers make extensive use of barrier synchronization. We show the need for barrier synchronization supported directly in hardware for tightly coupled algorithms. For a fixed problem size, the performance of Gauss-Jordan elimination crosses that of Gauss elimination as we increase the number of processors, even though the latter algorithm has a lower operation count. Sometimes, one can profit by trading operations for a better load balance and lower relative synchronization cost in a parallel algorithm.

20621 **Optimization of the computational load of a hypercube supercomputer onboard a mobile robot.** Barhen, J.; Toomarian, N.; Protopopescu, V. (California Institute of Technology, Jet Propulsion Laboratory, 4800 Oak Grove Dr., Pasadena, CA 91109). *Applied Optics;* **26**: No. 23, 5007-5014(1 Dec 1987).

A combinatorial optimization methodology is developed, which enables the efficient use of hypercube multiprocessors onboard mobile intelligent robots dedicated to time-critical missions. The methodology is implemented in terms of large-scale concurrent algorithms based either on fast simulated annealing, or on nonlinear asynchronous neural networks. In particular, analytic expressions are given for the effect of single-neuron perturbations on the systems' configuration energy. Compact neuromorphic data structures are used to model effects such as precedence constraints, processor idling times, and task-schedule overlaps. Results for a typical robot-dynamics benchmark are presented.

20622 **SPRINT - The systolic processor with a reconfigurable interconnection network of transputers.** De Groot, A.J.; Johansson, E.M.; Fitch, J.P.; Grant, C.W.; Parker, S.R. (Engineering Research Div., Lawrence Livermore National Lab., P.O. Box 808 L-156, Livermore, CA 94550). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 873-877(Aug 1987). (CONF-870552—). Contract W-7405-ENG-48.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

The Systolic Processor with a Reconfigurable Interconnection Network of Transputers (SPRINT) is a sixty-four-processor multiprocessor developed at Lawrence Livermore National Laboratory for experimentally evaluating systolic algorithms and architectures. This paper describes the architecture of the SPRINT and several algorithms which have been executed on it.

20623 **Nulljob product.** Hughart, N.; Ritchie, D. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL 60510). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 914-916(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

The ever increasing demand for more CPU cycles for data analysis on the authors' Central VAX Cluster led them to investigate new ways to utilize more fully the resources that were available. A review of the experiment and software development VAX systems on site revealed many unused computing cycles. Furthermore, these systems were all connected by DECnet which would allow easy file transfer and remote batch job submission. A product was developed to allow jobs to be submitted on the Central VAX Cluster but actually to be run on one of the remote systems. The processing of the jobs was arranged, to the greatest extent possible, to be transparent to the user and to have minimal impact on both the Central VAX Cluster and remote systems.

20624 **EAGLES: An interactive environment for scientific computing.** Lawver, B.S.; O'Brien, D.W.; Poggio, M.E.; Shectman, R.M. (Engineering Research Div., Lawrence Livermore National Lab., P.O. Box 5504 L-156, Livermore, CA 94550). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 928-931(Aug 1987). (CONF-870552—). Contract W-7405-ENG-48.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

The EAGLES Project is creating a computing system and interactive environment for scientific applications using object-oriented software principles. This software concept leads to well defined data interfaces for integrating experiment control with acquisition and analysis codes. Tools for building object-oriented systems for user interfaces and codes are discussed. Also the terms of object-oriented programming are introduced and later defined in the appendix. These terms include objects, methods, messages, encapsulation and inheritance.

20625 **FBEXPERT - An intelligent assistant to diagnose FASTBUS.** Booth, A.W.; Carroll, J.T.; Gocrannson, G.T. (Fermi National Accelerator Lab., Batavia, IL 60510). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 987-991(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

The complexity of the FASTBUS network at CDF makes access to expert assistance a necessity for efficient operation. A software Expert System, called FBEXPERT, is being developed to diagnose FASTBUS errors and advise users on recovery options in the interactive Data Acquisition environment. The prototype expert system, FBEXPERT, has been developed using OPS5 and applied to the diagnosis of a FASTBUS network problem. This paper introduces some basic features of the OPS5 "knowledge engineering" language, as well as mentioning other aspects pertaining to the specific implementation of VAX OPS5. The paper includes an example which shows how FBEXPERT updates its knowledge base as it proceeds to the correct solution.

20626 **Architecture and an interconnection scheme for time-sliced buses.** Kovaleski, A.; Ratheal, S.; Lombardi, F. (Case/Rixom). *Journal of Parallel and Distributed Computing;* **4**: No. 2, 209(Apr 1987).

This paper describes an interconnection scheme based on a bus network consisting of high-speed time-sliced buses and interbus links of matching bandwidths. Simulation results and two contrasting approaches to simulating such a machine are discussed. The network is best applied to problems which exhibit locality in their communication patterns e.g., image processing.

20627 **Ab initio electronic structure calculations of small clusters.** Rohlfing, C.M. (Theoretical Div., Sandia National Labs., Livermore, CA 94550). pp 55 of The impact of supercomputers on chemistry (Book of abstracts). London, UK; ISOC 87 Secretarist, Room 209 (1987). (CONF-8704191—).

From 1. international conference of the impact of supercomputers on chemistry; London, UK (13 Apr 1987).

One of the many applications of supercomputers to computational quantum chemistry is the study of the physical and chemical properties of clusters. Several examples are presented, including the determination of bulk cohesive energy from correlated calculations of Be fragments and ground state geometries from gradient optimization and frequency analysis of Si clusters. The interactions between clusters modeling a bulk metal and other species are examined for He impurities inside an Al cage and CO chemisorbed on a Ni surface.

20628 **Use of new computer technologies in elementary particle physics.** Gaines, I.; Nash, T. (Advanced Computer Program, Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Annual Review of Nuclear Science;* **37**: No. 1, 177-212(1987).

Problems requiring the use of computers in experimental and theoretical high energy physics come from the complexity and the amount of data which must be analyzed in large center of mass energy experiments and from the development of lattice gauge solutions to QCD. The problems of triggering and event processing via new processor technology and high level language (FORTRAN) are reviewed. FORTRAN and parallel computer technology used in lattice gauge calculations are reviewed. (AIP)

20629 **Advanced compiler optimizations for supercomputers.** Padua, D.A.; Wolfe, M.J. *Communications of the ACM;* **29**: No. 12, 1184-1201(Dec 1986).

Supercomputers use parallelism to provide users with increased computational power. Most supercomputers are programmed in some higher level language, commonly Fortran; all supercomputer vendors provide Fortran compilers that detect parallelism and generate parallel code to take advantage of the architecture of their machines. This article discusses some of the common (and not so common) features that compilers for vector or multiprocessor computers must have in order to successfully generate parallel code. Many examples are given that are related to the generic types of machines to which they apply. Where appropriate, the authors relate these parallel compiler optimizations to those used in standard compilers.

20630 **Aspect insensitive incoherent optical pattern recognition.** Mersereau, K.; Gamble, F.T.; Grieser, D.R.; Hartman, N.F.; Verber, C.M. (Battelle, Columbus, OH). pp vp. of The fifth international congress on applications of lasers and electrooptics (Technical Digest). Toledo, OH; Laser Institute of America (1986). (CONF-861197—).

From ICALEO '86: laser application conference; Arlington, VA, USA (10 Nov 1986).

Optical Fourier transform filtering of the images from mail flats has proved capable of rapidly locating the destination address amid extraneous printed text and graphics. The utility of the technique derives from the frequent use of 8 to 10 characters per inch and 6 to 8 lines per inch spacing in the address but not in the remainder of the printing. The inherent speed of the optical F-T technique in combination with video-image/spatial-light-modulator image components show promise for address location at rates up to 10 mail pieces per second. This approach should lend itself to similar applications, such as locating distinctive patterns in the field of view of a robot vision system.

20631 **(AEEW-M—2217) Vector models in RETRAN-02 MOD 2.** Kinnersly, S.R. (UKAEA Atomic Energy Establishment, Winfrith). Jun 1985. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750914/JAW.

The vector momentum model in RETRAN-02 allows momentum flux to be modelled in two dimensions. Vector models in RETRAN-2 are described, including both the actual implementation in the code and the specification given in the code manual. The vector momentum model is described in detail. Other models which use vector quantities include models for volume average flow, volume average slip velocity, volume average phase velocities and fill junction flows. Both code implementations and code manual descriptions are described and inconsistencies noted. The differences between the standard RETRA-02 Mod 2 version and the Winfrith version RETN2204 are noted. (U.K.).

20632 **(ANL/TM—459) Survey of ANL organization plans for word processors, personal computers, workstations, and associated software.** Opitz, L.C.; Slocum, R.E. (Argonne National Lab., IL (USA)). Oct 1987. Contract W-31109-ENG-38. 88p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88005566/JAW.

At the Office Automation Advisory Committee's request, Computing Services has produced this Survey of ANL Organization Plans for Word Processors, Personal Computers, Workstations, and Associated Software. We collected this information from the various Argonne organizations in September and October of 1987. The specific purposes of this Survey are to document each organization's plans for office automation, to identify appropriate planners and other contact people in those organizations, and to promote the sharing of this information among those people making plans for organizations and decisions about office automation. The Survey supplements information in both the ANL Statement of Site Strategy for Computing Workstations (ANL/TM 458) and the ANL Site Response for the DOE Information Technology Resources Long-Range Plan (ANL/TM 449).

20633 **(BARC—1333) Development of a method to transfer counting data from series-88 multi parameter Canberra system to ND-560 computer.** Rattan, S.S. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE87703142/JAW.

A method has been developed to transfer counting data from the SERIES-88 multi parameter CANBERRA system to ND-560 computer. The Series-88MP CANBERRA system can be used as single parameter system in Pulse Height Analysis (PHA) mode as well as multi parameter system in List mode simultaneously. The magnetic tape containing the data of Series-88MP CANBERRA system is read in PRIME-450 computer in BINARY format with a density of 800 bpi using MAGNET option. The file is read from the magnetic tape using record size as 2 x 384 in the case of PHA mode and 2 x 2048 in the case of List mode. A computer program was developed in PRIME-450 computer to convert the data from BINARY format to digital format. This digital output is transfered

to ND-560 computer after storing on a magnetic tape in the EBCDIC format. Suitable computer programs were developed in ND-560 computer to convert this digital data of PHA mode and List mode to actual output. 3 references.

20634 (BARC—1344) Computer program in Basic language for computation of spectrochemical analytical data. Rajachandrasekar, R.; Kulkarni, P.G.; Joshi, M.V. (Bhabha Atomic Research Centre, Bombay (India)). 1986. 32p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701229/JAW.

The spectrochemical computations of transforming optical density data into concentrations, hitherto done on 'Respektra' calculating board are time consuming. In order to speed up these calculations, a computer program has been devised in HI-BASIC language which can be used in HP-9845B desktop computer (Hewlett Pakcard, USA). The programs carry out the tasks of the emulsion calibration, background correction, intensity ratio calculation, plotting of working curves, printout of results of individual elements, working curves (on option) and collective results of all elements in a given sample. 6 refs., 2 tables, 4 figures.

20635 (BARC—1349) Project monitoring package (PMP): A package for project activity monitoring. Vyas, K.N.; Kannan, A.; Susandhi, R.; Basu, S. (Bhabha Atomic Research Centre, Bombay (India)). 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701234/JAW.

A package for preparing PERT/CPM network diagrams has been written for PDP-11/34. The program uses PLOT-10 library calls for device interfacing. The package is essentially non-interactive in nature, and reads input data in the form of activity description and duration. It calculates the critical path time and performs time scaling of the events. The report gives a brief outline of the logic used, a sample plot and tabular output for reference. An additional facility for performing project activity monitoring has also been implemented. Activity monitoring generally requires various reports such as feed back reports from various group co-ordinators, information report for project co-ordinator and brief periodical reports for management. A package 'DATATRIEVE' (DTR) on PDP-11/34 system is utilized for generating the above mentioned reports. As DTR can also use normal sequential files, an interfacing program has been written which reformats the files accepted by PERT program acceptable to DTR. Various types of reports as generated by DTR are included. However this part of the package is not transportable and can be implemented only on systems having DTR. 6 figures.

20636 (BARC—1358) Computerised output of phonetic codes in Devanagari script by dot-matrix printers. Somasundaram, S.; Suri, M.M.K.; Khatua, R. (Bhabha Atomic Research Centre, Bombay (India)). 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701242/JAW.

This report describes the development of a computer software for converting hex-octal, alpha-numeric and pure-alpha mode input in English into 'phenetic Devanagari characters', which can be printed through dot-matrix printers in 2 passes of print-head, along with English text in the same lines. If multilingual terminals presently available in India, are used, it requires 4 passes of print-head for printing phonetic Devanagari characters, and English text also is converted into phonetic Devanagari script during printing. Thus, the software reported in this, is an improvement over the facilities currently available in Indian market. 9 tables, 2 refs.

20637 (CEGB-TPRD/B—0776/R86) Quality assurance aspects of the computer code CODAR2. Maul, P.R. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Mar 1986. 16p. (ODMWG/P—85-15). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750824/JAW.

The computer code CODAR2 was developed originally for use in connection with the Sizewell Public Inquiry to evaluate the radiological impact of routine discharges to the sea from the proposed PWR. It has subsequently bee used to evaluate discharges from Heysham 2. The code was frozen in September 1983, and this note gives details of its verification, validation and evaluation. Areas where either improved modelling methods or more up-to-date information relevant to CODAR2 data bases have subsequently become available are indicated; these will be incorporated in any future versions of the code.

20638 (CEGB-TPRD/B—0869/R86) Steam release into buildings: the modelling of steam condensation. Telford, A.R.R.; Elston, M.J.H. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Nov 1986. 41p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750958/JAW.

A lumped-parameter code, HOTSTM, has been developed to model the thermal transient resulting from a steam jet discharging into a large ventilated building, typical of CEGB power plant installations. The code is designed to deal with high pressure steam jets whose typical dimension is small compared with that of the building, so that there is good good mixing within the building. An important factor in limiting the temperature rise of the air/steam mixture is heat transfer to the internal surfaces of the building, the temperatures of which are significantly affected by condensation. A detailed description is given of the method used in HOTSTM to calculate condensation and evaporation on internal building surfaces. The method exploits the well-known analogy between heat and mass transfer, together with correction factors derived from a simplified analytical solution. The validity of the approximations inherent in the method is estimated to affect predictions of bulk gas temperature by only a few degrees. A complete listing of the code, as used for calculating thermal transients in Bradwell Turbine House, is appended to the Report. This is intended as a record of the calculational route used in that work, not as a user's guide to the program.

20639 (CIEMAT—596) Program Leps to addition of gamma spectra from germanium detectors. Romero, L. (Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas, Madrid (Spain)). 1986. 38p. (In Spanish). NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701251/JAW.

The "LEPS" program, written in FORTRAN IV, perform the addition of two spectra, collected with different detectors, from the same sample. This application, adds the two gamma spectra obtained from two opposite LEPS Germanium Detectors (Low Energy Photon Spectrometer), correcting the differences (channel/energy) between both two spectra, and fitting them before adding. The total-spectrum is recorded at the computer memory as a single spectrum. The necessary equipment, to run this program is: two opposite germanium detectors, with their associate electronics. Multichannel analyzer (2048 memory channel minimum). Computer online interfacing to multichannel analyzer. (author). 4 refs., 3 figs.

20640 (DOE/ER/12046—T4) Computer aided surface representation. Barnhill, R.E. (Arizona State Univ., Tempe (USA). Dept. of Computer Science). Feb 1987. Contract AC02-82ER12046. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005408/JAW.

The proposed Surfaces research can be classified into two general categories involving: the creation of new surface forms and the determination of geometric and physical properties of these and other surfaces. The specific research problems to be addressed in this project for the Department of Energy include the following surface construction - piecewise polynomial interpolants, scattered data interpolants, and surfaces defined on surfaces; geometric and physical properties - numerical integration and surface interrogation. 18 refs.

20641 (DOE/ER/25001—91) A polynomial based iterative method for linear parabolic equations. Schaefer, M.J. (Illinois Univ., Urbana (USA). Center for Supercomputing Research and Development). May 1987. Contract FG02-85ER25001. 90p. (CSRD—661; UILU-ENG—86-8003-05/87). NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE88003535/JAW.

A new polynomial based method (PBM) is developed to integrate multi-dimensional linear parabolic initial-boundary-value

problems. It is based on L_2-approximations to f(z) = (1 - exp(-z))/z, f(0) = 1, over ellipses in the complex plane using expansions of f in Chebychev polynomials. The calculation of the Fourier coefficients requires numerical integration over only a single line segment in the complex plane whose length and orientation depend on the step size and the parabolic operator itself. The simplicity with which these coefficients are obtained rests on special properties of the Chebychev polynomials. Most of the work in PBM consists of matrix-vector multiplications, involving a matrix L which arises from the spatial discretization of the differential operator. To be specific, PBM integrates the semi-discrete problem u/sub t/ = L(t)u + b(t), u,b in R/sup n/ and L in R/sup n x n/, and requires only a modest amount of storage (a few vectors of order n). Due to the analyticity of f it has good convergence properties and compares favorably to other standard methods from the classes of Hopscotch, Alternating Direction Implicit (ADI) and Locally One-Dimensional (LOD) schemes, as measured by the CPU-times required on a single CPU of a CRAY X-MP/24. It is also competitive with Crank-Nicolson which we couple with two proven iterative solvers. I recommend PBM on problems which require fourth order spatial accuracy, problems whose solutions contain significant high-frequency components, and problems whose operators cannot be split conveniently in an ADI or LOD fashion (for example, problems with mixed derivatives). 30 refs., 11 figs., 12 tabs.

20642 (DP-MS—87-141) Personal computers and All-In-1; Document transfer and translation. Stanland, C.F. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1987. Contract AC09-76SR00001. 6p. (CONF-871248—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88003760/JAW.

From Digital Equipment Computer Users Society fall symposium; Anaheim, CA, USA (7 Dec 1987).

The Savannah River site is currently utilizing a multi-vendor approach to provide Office Automation. Personal computer workstations include the Apple Mackintosh, IBM PC, DEC Rainbow and DEC VAXmate. Users of these workstations typically employ a variety of word processing and graphics packages to produce documents, many of which need to be exchanged in revisable form with users of different word processing packages. Since most of these users are utilizing terminal emulators to access the departmental ALL-IN-1 systems, the need/desire to translate and/or transfer workstation-created documents via electronic mail naturally arose. We will discuss our enhancements to document transfer capabilities of ALL-IN-1 to support host-initiated file transfer to and from any of the above mentioned workstations. Documents, including attachments, may be uploaded to, or down baded from, ALL-IN-1 in their native format or with conversion. Document conversions are performed "transparently" using ALL-IN-1 DSAB's or third party packages with attributes such as rulers, soft returns, bolding, and underscoring preserved. Support for translation independent of transfer is also provided and a "Get From Personal Computer" option has been added to the editor menus. Included in our discussion will be a summary of the supported terminal emulator file transfer packages, the various workstation to VAX hardware connections utilized, and the capabilities of the file conversion packages that are currently available.

20643 (FNAL-TM—1508) Finite State Tables for general computer programming applications. Leininger, M. (Fermi National Accelerator Lab., Batavia, IL (USA)). Jan 1988. Contract AC02-76CH03000. 16p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88006254/JAW.

The Finite State Table is a computer programming technique which offers a faster and more compact alternative to traditional logical control structures such as the IF-THEN-ELSE statement. A basic description of this technique is presented. The application example is the creation of plot output from engineering analysis and design models generated by I-DEAS, a commercial software package used for solid modeling, finite element analysis, design and drafting.

20644 (ITEF—61(1986)) Adjoining of the MARS-4 and MMK-22 codes for calculating the reaction rates for neutrons produced in a medium under high-enrgy particle irradiation. Kazaritskij, V.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki). 1986. 24p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701370/JAW.

Principles of adjoining of the MARS-4 codes designed for simulation of high-energy particle transport and the MMK22 program designed for simulation of low-energy neutron transport are considered. BESM-6 software of adjoining to solve problems on estimation of neutron reaction rates in media bombarded by particle beams is described. For some targets irradiated by protons the neutron yields and corresponding reaction rates are calculated. Comparing the data published, one concludes that divergencies in functionals investigated recur the divergencies in values of initial nuclear data and don't exceed mainly the scale of these initial divergencies. 11 refs.; 3 tabs.

20645 (JINR—R-10-86-806) Procedure for initial data input and checkup in the system for film data mathematical processing. Balgansurehn, Ya.; Buzdavina, N.A.; Zaikina, A.G.; Ivanov, V.G.; Pervushov, V.V.; Ehrdehnehdehlgehr, T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1986. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88700926/JAW.

A procedure for input and checkup of initial data in the system for film data mathematical processing is described. Within the procedure the following tasks are solved: sorting of measurements by event numbers; transformation of measurement results obtained from different measurement systems to the standard form; revealing the measurements which contain fatal errors; checkup of the measurement quality. 11 refs.; 3 figs.; 1 tab.

20646 (KFK—4283) SANDCMOT user instructions. Henkel, P.R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Sep 1987. 61p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751940/JAW.

This report includes a formal code description of the SANDCMOT program that is used to analyse sodium boiling and clad motion phenomena during the initiation phase of loss-of-flow accidents within LMFBR's. The code input, a flow chart, a short characterization of the major subroutine's function as well as a list of main variables are presented. A detailed description of the relevant physics can be found in previous reports enumerated in the reference list.

20647 (LA—11082-MS) A curve-fitting package for personal computers. Rinard, P.M.; Goldman, A. (Los Alamos National Lab., NM (USA)). Nov 1987. Contract W-7405-ENG-36. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE88005075/JAW.

A curve-fitting routine based on the Deming method has been developed into a package for personal computers. In addition to the curve-fitting portion, the package includes a data editor, a plotting package, statistical analyses, and interpolation routines. This report describes the features of the package, the algorithms used, and suggestions on how to run it most effectively. Although several languages and computers have been used with the package over the years, this report applies to them all in a general manner.

20648 (MHSMP—87-51) An IBM PC version of ASENT. Ashcraft, R.W. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). Dec 1987. Contract AC04-76DP00487. 23p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004244/JAW.

ASENT, a FORTRAN program developed by Sandia National Laboratories, Albuquerque, has been converted to Microsoft QuickBASIC for use on the IBM PC. The new version includes a

plotting routine which is CGA compatible. A listing of the program and a sample data case are given in the Appendix. 2 refs.

20649 (NEI-NO—30, pp 14) **Vectorization and parallelization of a reservoir simulator.** Henriquez, A. (Statoil, Norway). 1986. NTIS (US Sales Only), PC A14/MF A01. Order Number DE88751203/JAW. (CONF-8609372—).

From Seminar on reservoir description and simulation with emphasis on EOR; Oslo, Norway (3 Sep 1986).

Co-sponsored by Scientific Software-Intercomp, London (UK).

A commercially available black-oil simulator used at Statoil has been vectorized on an IBM 3090-200/VF. The first release of the vector hardware and software supplied by the vendor has been extensively tested in this process. A vectorized version of the code has been on production for several months, with performance as expected. Speed-up for some chosen subroutines of the linear solver has been up two to six times the scalar version in the IBM 3090. The total speed-up with respect to the previous machine IBM 3081 KX, is in the range of four to six. Possibilities of parallelizing the black-oil simulator at the level of isolated structures have been investigated. The expectations are such that a project to include this option has been stated, as it is hoped to achieve significant improvements in throughput times. 9 refs., 2 figs.

20650 (ORNL/CSD/TM—256) **A primer for TSO [Time Sharing Option] and TSO/ISPF.** Begovich, C.L. (Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 153p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE88006154/JAW.

This manual is an introduction to the use of TSO (Time Sharing Option) and ISPF (Interactive System Productivity Facility) on the Martin Marietta Energy Systems, Inc. central MVS computer systems. It is designed to provide programmers who want to begin using TSO or ISPF with the information necessary to perform the functions for which these systems are most commonly used. A quick reference for more experienced users is also provided.

20651 (RFP—4108) **RSX-11M on floppy disks.** Neitzel, R. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 1987. Contract AC04-76DP03533. 18p. (CONF-870471—2). NTIS, PC A03. Order Number DE88005283/JAW.

From DECUS spring meeting; Nashville, TN, USA (27 Apr 1987).

When faced with an application that requires RSX, disk storage, stand-alone operation, the ability to switch from production of one item to totally unrelated item quickly and a hardware configuration that has only two RX02 drives, using RSX-11S is not necessarily a viable solution. The problem is only increased if disk space is at a premium. However, if the system requires few of the development aids often associated with disk-based RSX the task is not at all difficult. With VMR a system image can be created that will fit onto a floppy and be within the size constraints as well. A description is given of how the output of a standard sysgen, which generated our 'full-blown' development system, is modified by VMR to fit our target system which currently is running on thirty production workstations. In addition, by the time this paper is presented DECnet will be added to the floppy based system.

20652 (SAND—87-2356C) **SAS [Statistical Analysis System] by forms: Putting statistical power into the hands of an end-user.** Lee, J.W. (Sandia National Labs., Albuquerque, NM (USA)). Sep 1987. Contract AC04-76DP00789. 7p. (CONF-880321—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88002217/JAW.

From SAS Users Group international (SUGI-13); Orlando, FL, USA (27 Mar 1988).

Statistical Analysis System (SAS) software provides a high level programming tool for data analysis, presumably with little effort. However, the flexibility of the language and its multitudinous options can both intimidate and confuse a casual user of SAS. How can the full power of SAS be integrated in such a way that end-users with limited training can perform their own analyses without sacrificing flexibility? This paper describes how SAS has been integrated into a menu-driven system which can be adapted to an extensible set of SAS procedures in a dynamic data environment. The system operates under VMS and utilizes the DIGITAL FMS Forms Management System. 1 ref., 8 figs.

20653 (SAND—87-2449C) **An intelligent interface to SAS for use by product development engineers.** Spencer, D.D. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 12p. (CONF-880321—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88000744/JAW.

From SAS Users Group international (SUGI-13); Orlando, FL, USA (27 Mar 1988).

An intelligent interface to SAS for a restricted set of analysis needs is being developed at Sandia National Laboratories in Albuquerque, New Mexico. The environment in use is a VAX cluster running under VMS 4.5. An existing data retrieval and analysis system is being updated with the intent that the engineering (or other non-statistician) users will be able to satisfy the simpler of their analysis needs themselves; the backbone of the analysis part of the system is SAS. Since more conventional attempts to make SAS accessible to all users were not as successful as hoped, the need for an artificially intelligent interface to SAS, tailored to the particular needs of this group of users, has been identified. Such an interface is in the development progess. The interface consists of three basic modules of knowledge: SAS data manipulation, SAS graphics, and "routine" statistics, currently restricted to the simple statistical comparison of two or more groups. This paper describes the target users and their environment, the problems they have using SAS, and a description of the intelligent interface.

20654 (SAND—87-3026C) **The New Report Writer: More than just a migration path.** Schofield, J.R. Jr. (Sandia National Labs., Albuquerque, NM (USA)). Dec 1987. Contract AC04-76DP00789. 18p. (CONF-880233—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004536/JAW.

From SHARE conference; Anaheim, CA, USA (28 Feb 1988).

The COBOL ANS-85 standard is now over two years old. VS COBIL II, which complies with many of the new standard's features, predates the formal acceptance of the ANS-85 standard. During the same period another product has gone relatively unnoticed. The New Report Writer (NRW) has been quietly improving programmer productivity before the emergence of either the new standard or VS COBOL II. Recently, however, the NRW has been identified as providing a migration path to VS COBOL II for OS COBOL users. Prior to the NRW announcement in December of 1986, OS COBOL installations that used the Report Writer (RW) Module could not migrate those applications to VS COBOL II. The immediate migration-path appeal of the NRW has overshadowed another significant advantage of its use - productivity. The NRW qualifies as a productivity tool with measurable results. Initially targeted as such, its introduction into the marketplace preceded the release of VS COBOL II. Obviously then, the NRW also interfaces with OS COBOL, COBOL-74 RW code, and COBOL-68 RW code. The preceding text conveys experiences with Report Writer code transported from a UNiSYS environment to an IBM VS COBOL II environment. So, while the NRW provides a migration path for VS COBOL II Report Writer users, it also provides an exceptional framework for COBOL report development and maintenance. As a precompiler, its output is source to the COBOL compiler, and the inefficiencies of interpretive languages are avoided. Lastly, the NRW (Program Number 5798-DYR, manuals 5626-4301 and 5626-4302) is reasonably priced and is probably one of IBM's unintentionally best-kept secrets. 6 figs.

20655 (SRD-R—359) **CRACUK model description (appendices to the CRAC2 model description).** Nixon, W.; Egan, M.J. (UKAEA Safety and Reliability Directorate, Culcheth). Aug 1986. 18p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88750927/JAW.

The CRACUK computer code is a revised version of the US consequence modelling code CRAC2, adapted to suit UK requirements. The revisions include modifications to the models for spatial interval representation, weather sequence sampling, atmospheric dispersion, dosimetry and countermeasures. This document

describes, in the form of appendices to the CRAC2 model description, each of the revisions made to the original model which collectively distinguish CRACUK from CRAC2.

20656 **(SRD-R—382) AEROSIM-S [aerosol modelling code] user manual.** Ramsdale, S.A. (UKAEA Safety and Reliability Directorate, Culcheth). Nov 1986. 28p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88750969/JAW.

AEROSIM is a computer code written and developed at SRD, which models the behaviour of aerosol particles in a closed, well-mixed volume. It makes use of the numerical package FACSIMILE to integrate the aerosol equation. This report describes the input and output and the physical modelling in the standard version of AEROSIM, AEROSIM-S, which forms the basis of all other versions of AEROSIM being developed. AEROSIM-S treats 'dry' aerosol processes, i.e. those not involving a condensible atmosphere. It is therefore suitable for fast reactor secondary containment applications.

20657 **(STF—15A86065) Royal DEBAC. Guidance for user.** Bryn, J.; Harsem, T.T. (SINTEF, Trondheim (Norway)). Dec 1986. 61p. (In Norwegian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751221/JAW.

The report presents the computer program Royal DEBAC for the simulation of climate conditions, power demand and energy consumption in special constructions. Glazed yards have been analysed in particular, but systems such as energy storage in the ground and hollow floors have been evaluated by the program. In addition, the program evaluates structural models such as the development and integration of building zones and air ventilation. The basic method the development of a structural model for glazed yards is shown by examples. The input data, input file and matrix, program testing and data output together with graphic temperature output, are described. In the appendix examples are given. 16 drawings, 3 tables.

20658 **(STF—15A86065-App.) Royal DEBAC. Appendices.** Bryn, I. (SINTEF, Trondheim (Norway)). Dec 1986. 63p. (In Norwegian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE88751220/JAW.

Abstract, see main report.

20659 **(UCID—21327) Experimental verification of a finite-difference time-domain thin slot algorithm.** Pennock, S.T.; Yee, K.S.; Kasher, J.C. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005572/JAW.

A current area of interest in finite-difference time-domain computer is in developing the ability to model items of less than one cell in extent. A special case of this is an attempt to provide an algorithm to model thin slots, (much less than one cell dimension), without resorting to small cells which would increase storage and time requirements. Such an algorithm has been written by Yee and Kasher, and seems to work well. However, to lend real confidence to the algorithm's effectiveness, comparison with experimental data was deemed necessary. To this end, a series of experiments were carried out in the Lawrence Livermore National Laboratory's EMPEROR facility. This report will describe the measurements, the facility in which they were taken, and will conclude with a comparison of the experimental data and the results obtained from a finite-difference code with the thin slot algorithm. The comparison show that the thin slot algorithm performs as well or better than expected, with generally less than a factor of 2 difference in amplitude. 6 refs., 134 figs.

20660 **(UCRL—15935) AITI Test Report 87-002: Pratt and Whitney technical order transfer tests.** (SYSCON Corp., San Diego, CA (USA)). 12 Jun 1987. Contract W-7405-ENG-48. 40p. NTIS, PC A03. Order Number DE88004045/JAW.

The AFLC/AITI Standards Project is testing the Military Standard for the Automated Interchange of Technical Information, MIL STD-1840 (the Standard). The objective of the tests is to demonstrate the validity of the transfer protocol defined in the Standard itself and the viability of standardized formats for the transfer of technical information defined in other specifications used by the Standard.

20661 **(UCRL—15952) AITI Report 87-003: Honeywell technical order transfer tests.** (SYSCON Corp., San Diego, CA (USA)). 9 Jul 1987. Contract W-7405-ENG-48. 40p. NTIS, PC A03. Order Number DE88004046/JAW.

The AFLC/AITI Standards Project is testing the Military Standard for the Automated Interchange of Technical Information (the Standard). The objective of the tests is to demonstrate the validity of the transfer protocol defined in the Standard itself and the viability of standardized formats for the transfer of technical information defined in other specifications used by the Standard.

20662 **(UCRL—97418-Rev.1) The automated symbolic derivation of state equations for dynamic systems.** Macfarlane, J.; Donath, M. (Lawrence Livermore National Lab., CA (USA); Minnesota Univ., Minneapolis (USA)). Sep 1987. Contract W-7405-ENG-48. 10p. (CONF-880315—3-Rev.1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE88005222/JAW.

From 4. IEEE conference on artificial intelligence applications; San Diego, CA, USA (14 Mar 1988).

A system which is capable of generating symbolic state equations for dynamic systems is described. The underlying object-oriented knowledge representation structure is based on the bond graph modelling methodology which abstracts a complex system into a network of simple relations that describe the behavior of the system. Constraint propagation techniques provide a method for determining the causal relationships that must exist between system variables in a state determined system, thereby identifying a set of state variables for the system. The relation network and the state variables are manipulated by MACSYMA to define the state equations for the physical system dynamics. The availability of state equations in symbolic form allows the engineer to assess the influence of component parameters on the overall function of the physical system without having to resort to simulation iterations. This representation establishes the foundation for a model based reasoning system currently under development.

20663 **(UCRL—97571) PC-based CAD in an R & D environment.** Hensley, G. (Lawrence Livermore National Lab., CA (USA)). 19 Oct 1987. Contract W-7405-ENG-48. 7p. (CONF-8711146—1). NTIS, PC A02. Order Number DE88005419/JAW.

From WESCON conference; San Francisco, CA, USA (17 Nov 1987).

This paper describes some of the benefits of using computer aided design for integrated circuit design. 9 figs. (JDH)

20664 **(UCRL—97996) The use of personal computers in reactor physics.** Cullen, D.E. (Lawrence Livermore National Lab., CA (USA)). Jan 1988. Contract W-7405-ENG-48. 9p. (CONF-871262—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE88005676/JAW.

From International Atomic Energy Agency's consultant meeting on reactor physics calculations using small computers; Vienna, Austria (8 Dec 1987).

This paper points out that personal computers are now powerful enough (in terms of core size and speed) to allow them to be used for serious reactor physics applications. In addition the low cost of personal computers means that even small institutes can now have access to a significant amount of computer power. At the present time distribution centers, such as RSIC, are beginning to distribute reactor physics codes for use on personal computers; hopefully in the near future more and more of these codes will become available through distribution centers, such as RSIC.

20665 Overview of the TFTR computer system. Davis, S.L.; Sauthoff, N.R.; Stark, W. (Princeton Univ., Plasma Physics Lab. (PPPL), Princeton, NJ 08544). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 718-722(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

The Tokamak Fusion Test Reactor (TFTR) is an experimental device built to study the physics and engineering problems of magnetically confined plasmas with temperatures and densities close to those that would exist in an actual fusion reactor. One of the prime goals of TFTR is to reach scientific breakeven, which is defined as the point where the amount of power used to maintain plasma temperatures is equal to the amount of power released through fusion reactions. The purpose of this paper is to give an overview of the computer system that provides the control, monitoring, data collection and analysis functions for TFTR.

20666 Data acquisition system for the Sandia Particle Beam Fusion Accelerator II. Boyer, W.B.; Bouchier, F.A.; Chaba, S.J.; Mattson, C.R. (Sandia National Labs., P.O. Box 5800, Albuquerque, NM 87185). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 733-738(Aug 1987). (CONF-870552—). Contract AC04-76DP00789.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

This paper describes the Data Acquisition System (DAS) for the Particle Beam Fusion Accelerator II (PBFA II) at Sandia National Laboratories. This DAS incorporates several advanced features over those developed for previous pulsed power facilities at Sandia. Some major improvements are the use of LeCroy 6880 waveform recorders, multiplexing up to 4 signals on each 6880, dual, 32-bit, virtual memory computers, a pulsed reference source automatic waveform recorder calibration system, and LeCroy 4208 time-interval digitizers.

20667 A VME/VMX - CAMAC interface and crate controller. McParland, C.; Bieser, F. (Lawrence Berkeley Lab., Berkeley, CA 94720). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 751-755(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

A VME/VAX bus interface has been designed and built to interface a VME-based data acquisition system to CAMAC. The interface communicates via a differential bus with a companion unit that functions as a CAMAC crate controller. The interface maps both VME and VMX address cycles into appropriate CAMAC cycles. Special diagnostic features have been incorporated in the design to allow quick fault detection and location.

20668 Fermilab fast parallel readout system for data acquisition. Vignoni, R.; Barsotti, E.; Bracker, S.; Hansen, S.; Pordes, R.; Treptow, K.; White, V.; Wickert, S. (Univ. of La Plata). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 756-759(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

Three modules have recently been developed at Fermilab to provide high speed parallel readout of data for high energy physics experiments. This paper describes how these modules provide a fast and efficient method for transferring CAMAC event data into VME-based or FASTBUS-based memories, thus enhancing and extending the usefulness of experiments' large investments in CAMAC hardware. Using these modules can decrease the dead time of and experiment by up to a factor of 10. This paper includes a discussion of the experiment topologies in which these modules are being used.

20669 Real time control of the SSC string magnets. Calvo, O.; Flora, R.; MacPherson, M. (Fermi National Accelerator Lab., P.O. Box 500 MS 308, Batavia, IL 60510). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 760-762(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

The system described in this paper, called SECAR, was designed to control the excitation of a test string of magnets for the proposed Superconducting Super Collider (SSC) and will be used to upgrade the present Tevatron Excitation, Control and Regulation (TECAR) hardware and software. It resides in a VME orate and is controlled by a 68020/68881 based CPU running the application software under a real time operating system named VRTX.

20670 The VAXONLINE software system at Fermilab. White, V.; Heinicke, P.; Berman, E.; Constanta-Fanourakis, P.; MacKinnon, B.; Moore, C.; Nicinski, T.; Petravick, D.; Pordes, R.; Quigg, L. (Data Acquisition Software Group, Computing Dept., Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL 60510). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 763-767(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

The VAXONLINE software system, started in late 1984, is now in use at 12 experiments at Fermilab, with at least one VAX or MicroVax. Data acquisition features now provide for the collection and combination of data from one or more sources, via a list-driven Event Builder program. Supported sources include CAMAC, FASTBUS, Front-end PDP-11's, Disk, Tape, DECnet and other processors running VAXONLINE. This paper describes the functionality provided by the VAXONLINE system, gives performance figures and discusses the ongoing program of enhancements.

20671 Upgrade of MHD data acquisition system from ISX-B to ATF. Bell, J.D.; Pare, V.K. (Computing and Telecommunications Div., Martin Marietta Energy Systems, Inc.). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 768-771(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

The data acquisition system assembled to study magnetohydrodynamic (MHD) activity on the Impurity Study Experiment (ISX-B) tokamak at Oak Ridge National Laboratory (ORNL) is being revised for use on the Advanced Toroidal Facility (ATF). The new hardware and software architectures are based on ISX-B experience and will feature (1) different modes of operation for strong various subsets of available data, (2) a user interface that requires less routine activity than the earlier system, and (3) continued support of calibration and testing measurements used on ISX-B. The new hardware organization and software components are described in detail.

20672 Software strategies and hardware upgrades to the PPL data acquisition system (DAS). Davis, W.M.; Roney, P.; Gibney, T.; Funk, P.; Keller, M.; Sauthoff, N.; Davis, S.; Bates, G.; Corneliussen, M.; Fishman, H. (Plasma Physics Lab., Princeton Univ., Princeton, NJ 08544). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 775-781(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

This paper describes upgrades to the Data Acquisition System for the Experimental Projects Department at PPL, especially in support of the PBX-M upgrade to be completed this year. Hardware and software maintenance problems with the old configuration, consisting of a DEC KL-10 and eight PDP-11's, are de-

scribed. The real-time software and hardware performance requirements and projections for CAMAC I/O and data analysis and display are presented. Described are three applications that have real-time requirements and are located on separate processors, connected to PPPL's VAX Cluster by an Ethernet link. Building upon a previous large software base, general-purpose subroutine libraries and utilities are being emphasized. The most useful of these are described. The use of software packages from DEC, third-party vendors, and the fusion community, is also described. The new approaches to software development that are being incorporated into the DAS efforts are discussed. Specific future challenges are also described.

20673 **The CDF event-builder.** Booth, A.W.; Bowden, M.; Gonzalez, H.; Shaw, T.M.; Sinervo, P.; Baker, M.; Kwarciany, R.; Serich, E.; Van Conant, R.; Ragan, K. (Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL 60510). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 790-795(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

The Collider Detector at Fermilab (CDF) uses a FASTBUS network for real-time data acquisition (DAQ) with the current system comprising more than 500 FASTBUS modules. A central element in the DAQ pipeline is a hardware event builder whose role is to read out the front end scanners, reformat the data into YBOS bank structure, and transmit the data to a Level 3 trigger system which is composed of multiple processors from the Advanced Computer Project (ACP) at Fermilab. This paper describes the development of the hardware event-builder and includes some results from testing the prototype in reading out the detector, reformatting the data and writing it to the Level 3 ACP farm.

20674 **An implementation of the new IEEE standard routines for FASTBUS.** Kozlowski, T.; Foreman, W.M. (Los Alamos National Lab., Los Alamos, NM 87545). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 800-803(Aug 1987). (CONF-870552—). Contract W-7405-ENG-36.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

The authors implemented a subset of the new 1987 IEEE standard routines for FASTBUS for the General Purpose Master (GPM), a FASTBUS master developed at CERN. Experiences in implementing and using the new standard routines for FASTBUS are reported.

20675 **The design and performance of the parallel multiprocessor nuclear physics data acquisition system, DAPHNE.** Welch, L.C.; Moog, T.H.; Daly, R.T.; Videbaek, F. (Argonne National Lab., Argonne, IL 60439). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 822-825(Aug 1987). (CONF-870552—). Contract W-31-109-ENG-38.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

The ever increasing complexity of nuclear physics experiments places severe demands on computerized data acquisition systems. A natural evolution of these systems, taking advantage of the independent nature of "events", is to use identical parallel microcomputers in a front end to simultaneously analyze separate events. Such a system has been developed at Argonne to serve the needs of the experimental program of ATLAS, a new superconducting heavy-ion accelerator and other on-going research. Using microcomputers based on the National Semiconductor 32016 microprocessor housed in a Multibus I cage, CPU power equivalent to several VAXs is obtained at a fraction of the cost of one VAX. The front end interfaces to a VAX 11/750 on which an extensive user friendly command language based on DCL resides. The whole system, known as DAPHNE, also provides the means to replay data using the same command language. Design concepts, data structures, performance, and experience to date are discussed.

20676 **Distributed data acquisition for BNL802 I: The front end.** Le Vine, M.J.; Watson, W.A. III; Von der Schmitt, H.; Kaufman, S. (Physics Dept., Brookhaven National Lab., Upton, NY 11973). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 830-834(Aug 1987). (CONF-870552—). Contract AC02-76CH00016;W-31-109-ENG-38.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

The BNL experiment 802 acquisition system comprises three VME crates. Data from Camac- and Fastbus-resident digitizers is collected via 68000-based intelligent Camac interfaces and via a Fastbus-VMX DMA engine. Complete events are shipped to processor elements (68020/68881) for formatting and third-level trigger decisions before transmission to the VAX host.

20677 **The MEGA data acquisition system.** Oothoudt, M.A.; Amann, J.F.; Bolton, R.D.; Cooper, M.D.; Foreman, W.M.; Hogan, G.E.; Kozlowski, T.; Naivar, F.J.; Smith, W. (Los Alamos National Lab., Los Alamos, NM 87545). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 840-844(Aug 1987). (CONF-870552—). Contract W-7405-ENG-36;FG02-87ER40313.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

The MEGA experiment will acquire 3 MB/sec of data into a 9-crate Fastbus system controlled by a single Fastbus master. A second-level trigger will be implemented in a Fermilab Advanced Computer Program (ACP) farm of 32 Motorola 68020 microprocessors. Output from the ACP farm at a rate of 24 KB/sec will be sent to a MicroVAX II for taping.

20678 **The PPPL event control system (ECS), a dependency-driven process scheduler.** Gibney, T. (Plasma Physics Lab., Princeton Univ., Princeton, NJ 08544-0451). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 853-857(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

The Event Control System (ECS) is a VAX/VMS-based process scheduler for controlling the activation of data-acquisition and data-reduction and display programs. ECS provides the user the ability to specify inter-process "dependencies" which must be satisfied before a particular program (VAX/VMS process) is "activated". In addition, ECS regulates the number of "active" processes, selects processes for activation, and dynamically adjusts VMS priorities for the processes.

20679 **A simple and efficient interprocess communication system for actually using a laboratory computer network.** Preckshot, G.G.; Butner, D.N. (Lawrence Livermore National Lab., P.O. Box 5511 L-635, Livermore, CA 94550). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 858-864(Aug 1987). (CONF-870552—). Contract W-7405-ENG-48.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

An interprocess communication system (IPCS) is being developed at Lawrence Livermore National Laboratory to support a network of computers which do data acquisition and data processing for fusion experiments. The IPCS permits one to improve system performance by allowing one to move programs to different CPUs for increased efficiency or to add more CPUs for more parallel operation. The authors discuss motivations, architecture, implementation, usage and results of their experience with the IPCS.

20680 **The ACP branch bus and real time applications of the ACP multiprocessor system.** Hance, R.; Areti, H.; Atac, R.; Biel, J.; Cook, A.; Fischler, M.; Gaines, I.; Hubsy, D.; Nash, T.; Zmuda, T. (Advanced Computer Program, Fermi National Accelerator Lab., Batavia, IL 60510). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-34: No. 4, 878-883(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

The ACP Branchbus, a high speed differential bus for data movement in multiprocessing and data acquisition environments, is described. This bus was designed as the central bus in the ACP multiprocessing system. In its full implementation with 16 branches and a bus switch, it will handle data rates of 160 MByte/sec and allow reliable data transmission over inter rack distances. The authors also summarize applications of the ACP system in experimental data acquisition, triggering and monitoring, with special attention paid to FASTBUS environments.

20681 **A multiple node software development environment.** Heincke, P.; Nicinski, T.; Constanta-Fanourakis, P.; Petravick, D.; Pordes, R.; Ritchie, D.; White, V. (Fermi National Accelerator Lab., Computing Dept., / MS120, P.O. Box 500, Batavia, IL 60510). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-34: No. 4, 884-889(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

Experimenters on over 30 DECnet nodes at Fermilab use software developed, distributed, and maintained by the Data Acquisition Software Group. A general methodology and set of tools have been developed to distribute, use and manage the software on different sites. The methodology and tools are of interest to any group developing and using software on multiple nodes.

20682 **Praxis - An alternative to Ada.** Holloway, F.W.; Sherman, T.A. (Lawrence Livermore National Lab.). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-34: No. 4, 890-899(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

This report describes Praxis, a modern, complete, block structured, strongly typed, programming language, comparable to Ada, and with special emphasis toward meeting systems programming requirements on all level machines. Praxis is considered as a possible alternative to Ada in certain applications. Praxis has been used since 1980 on the distributed control system for the Nova high energy laser at Lawrence Livermore National Laboratory. A description of the intended applications, the history of development, and an overview of the features of the language with comparisons to the Pascal and Ada languages, are given. The features are described in four categories: general appearance, power, insurance of freedom from errors, and manageability.

20683 **Distributed data acquisition for BNL802 II: Software.** Watson, W.A. III; LeVine, M.J. (Physics Dept., Brookhaven National Lab., Upton, NY 11973). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-34: No. 4, 900-903(Aug 1987). (CONF-870552—). Contract AC02-76CH00016.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

Multiple processes running on a VAX and on VME-based processors allow up to 16 detector sub-systems to run independently or coupled, with an aggregate throughput of 600 Kbytes/sec. VMS facilities are used extensively for command definition, message passing, controlling access to CAMAC and high voltage modules, and maintaining shared data structures.

20684 **VMSMULTI enhancement.** Boni, P. (Nuclear Physics Lab., Univ. of Illinois, Champaign, IL 61820). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-34: No. 4, 904-906(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

VMSMULTI is a general purpose data analysis program which runs under VAX/VMS and is used for the analysis of data previously logged onto magnetic tape. This paper describes the enhancements to the latest version of Fermilab VMSMULTI. The existing analysis features were extended and the new ones - like storing and loading the histograms - were added/ The graphics library was exchanged for the new one which uses DI-3000 graphics from Precision Visuals. Modifications were made to run VMSMULTI in a batch mode, in VMS subprocess or detached process.

20685 **A multi-tasking laboratory data acquisition system under TSX-plus.** Jones, R.T. (Nuclear Physics Lab. and Dept. of Physics, Univ. of Illinois at Urbana-Champaign, Champaign, IL 61820). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-34: No. 4, 917-920(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

A laboratory data acquisition software package is presented which runs on a distributed system of several LSI-11 workstations coupled together by an ethernet network. Incorporating existing PDP-11 software such as Fermilab's RTMULTI, the system offers an effective solution to expansion limitations of the LSI-11 without a major modification of existing software.

20686 **VMS software for the Jorway-411 Interface.** Dorries, T.; Moore, C.; Pordes, R.; White, V. (Data Acquisition Software Group, Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL 60510). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-34: No. 4, 945-947(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

This reports on a Software Package to access CAMAC through the Jorway-411 Interface, for use on VAX/VMS systems. The software can be used to access parallel and/or serial CAMAC branch highways, and multiple Jorways may be connected to the VAX UNIBUS or Micro Vax QBUS. The software available includes a VAX/VMS device driver for the JORWAY-411 and support routines and programs that access the driver. The software is accompanied by extensive documentation. As discussed below, several of the packages originated from other institutions and have been enhanced by the Data Acquisition Software Group at Fermilab. The software package is in widespread use at Fermilab and over 20 other sites. The software can be run on any of the UNIBUS VAX-11 family of computers using a UNIBUS Jorway-411 to interface to CAMAC, or on a Microvax-II either interfaced to CAMAC through a Q-BUS Jorway-411, or through a Microverter and UNIBUS Jorway. The package includes facilities for performing CAMAC operations remotely. The VAX on which the user runs his or her program need not be directly connected to the Jorway. Server programs allow a VAX connected via DECNET or a PDP-11 connected via a DR11-W link to be the route for accessing the CAMAC hardware.

20687 **Multiprocessor data acquisition system.** Haumann, J.R.; Crawford, R.K. (Argonne National Lab., Electronics Dept., and Intense Pulsed Neutron Source Div., 9700 S. Cass Avenue, Argonne, IL 60439). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-34: No. 4, 948-953(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

A multiprocessor data acquisition system has been built to replace the single processor systems at the Intense Pulsed Neutron

Source (IPNS) at Argonne National Laboratory. The multiprocessor system was needed to accommodate the higher data rates at IPNS brought about by improvements in the source and changes in instrument configurations. This paper describes the hardware configuration of the system and the method of task sharing and compares results to the single processor system.

20688 **A CAMAC system controlled by an IBM AT computer for time-resolved spectroscopy.** Lindquist, L.O.; Moss, C.E. (Santa Fe Energy Research Corp., 801 Don Gaspar, Santa Fe, NM 87501). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 958-960(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

An IBM AT computer interfaced to a small CAMAC system offers considerable power without the complexity and expense of a large general-purpose system. The authors' system for time-resolved spectroscopy features menu-driven FORTRAN-based software; high-resolution and high-speed 98K channels, 5-μs fixed dead time) ADCs; segmentable histogram memories (24-bit counts) with large memory space for many histogram segments; independently variable separate histogram dwell times; remote control via a CAMAC serial highway; and ground isolation between the data acquisition equipment and control computer by means of fiber optics.

20689 **Experiences with Starburst front-end data preprocessing at LBL's superHILAC and 88-inch cyclotron.** Rathbun, W.; Leres, R.; Belshe, R.A. (Univ. of California, Lawrence Berkeley Lab., Berkeley, CA 94720). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 966-969(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

A Starburst processor, comprising a single-width CAMAC auxiliary crate controller with an on-board PDP 11/73 microcomputer and memory-mapped CAMAC interface, has been in service at the Laboratory for two years. It was originally implemented to allow zero-suppressed CAMAC data acquisition, but its versatility has led to the development of a front-end data acquisition language which can be used to significantly reduce acquisition deadtime and the volume of data recorded. Starburst has been implemented as a slave to the existing ModComp data acquisition computers, and has also been linked to a Micro VAX II computer through a standard parallel interface. Data format, system performance, and the data acquisition language and structure are discussed.

20690 **TFTR CAMAC systems and components.** Rauch, W.A.; Bergin, W.; Sichta, P. (Princeton Plasma Physics Lab., Princeton Univ.). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 970-975(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

Princeton's tokamak fusion test reactor (TFTR) utilizes Computer Automated Measurement and Control (CAMAC) to provide instrumentation for real and quasi real time control, monitoring, and data acquisition systems. This paper describes and discusses the complement of CAMAC hardware systems and components that comprise the interface for tokamak control and measurement instrumentation, and communication with the central instrumentation control and data acquisition (CICADA) system. It also discusses CAMAC reliability and calibration, types of modules used, a summary of data acquisition and control points, and various diagnostic maintenance tools used to support and troubleshoot typical CAMAC systems on TFTR.

20691 **Ion implantation data acquisition system.** Struttmann, D.A.; Anderl, R.A. (Idaho National Engineering Lab., EG and G Idaho Inc., P.O. Box 1625, Idaho Falls, ID 83415). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 976-979(Aug 1987). (CONF-870552—). Contract AC07-76ID01570.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

This paper describes a data acquisition system developed for hydrogen ion-driven permeation experiments for materials relevant to fusion technology. The system consists of an IBM PC-AT, CAMAC interface to diagnostic instrumentation and custom-developed software (BASIC) to provide time-history information for signals from several instruments including three quadrupole mass spectrometers.

20692 **The trigger supervisor: Managing triggering conditions in a high energy physics experiment.** Wadsworth, B.; Lanza, R.; Le Vine, M.J.; Scheetz, R.A.; Videbaek, F. (Lab. for Nuclear Science, Massachusetts Institute of Technology, Cambridge, MA 02139). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 980-983(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

The authors describe a trigger supervisor, implemented in VME-bus hardware, which enables the host computer to dynamically control and monitor the trigger configuration for acquiring data from multiple detector partitions in a complex experiment.

20693 **List processing software for the LeCroy 1321 segment manager interface.** Dorries, T.; Moore, C.; Pordes, R. (Data Acquisition Software Group, Fermi National Accelerator Lab., P.O. Box 500, Batavia, IL 60510). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 1000-1002(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

Many fixed target experiments at Fermilab now include some FASTBUS electronics in their data readout. The software reported in this paper, provides general support for the LeCroy 1821 interface. The list processing device drivers allow FASTBUS data to be read out efficiently into the Fermilab Computing Department supported data acquisition systems.

20694 **Fermilab smart CAMAC controller.** Hansen, S.; Graupman, D.; Bracker, S.; Wickert, S. (Fermi National Accelerator Lab., Batavia, IL). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 1003-1007(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

A camac controller which can store list of function codes in RAM and then execute these codes without delay between cycles is described. The data is routed to a high speed parallel port that can be connected to either a Fastbus or VME based buffer memory. A readout speed increase of up to three times over present acquisition systems can be realized.

20695 **A new VME-based, multi-processor data acquisition station for the LBL Bevalac.** McParland, C. (Lawrence Berkeley Lab., Berkeley, CA 94720). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **NS-34**: No. 4, 1012-1016(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

A new VME-based multi-processor data acquisition station has been developed for use at several LBL Bevalac facilities. This

system acquires and manipulates data from multiple CAMAC crates and transmits them via Ethernet to a central VAX facility for taping. Overall architecture is discussed and major hardware and software components are described.

20696 **The Los Alamos neutron scattering center data acquisition system.** Nelson, R.O.; Cort, G.; Gjovig, A.; Goldstone, J.A.; McMillan, D.E.; Ross, J.; Seal, J. (Los Alamos National Lab., Los Alamos, NM 87545). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-34: No. 4, 1017-1032(Aug 1987). (CONF-870552—).

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

The next generation of data acquisition systems for the Los Alamos Neutron Scattering Center consists of a FASTBUS system controlled by a DEC VAXstation II/GPX. The FASTBUS subsystem features four custom high-performance modules interfaced to the VAX through the commercialized version of the QPI. Control and analysis is supported with the multiwindow graphics capability of the workstation.

20697 **An intelligent VME-based CAMAC crate controller.** Scheetz, R.A.; Le Vine, M.J. (Physics Dept., Brookhaven National Lab., Upton, NY 11973). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-34: No. 4, 1033-1035(Aug 1987). (CONF-870552—). Contract AC02-76CH00016.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

A VME-resident Camac crate controller is described which maps all Camac functions into the address space of a 68000 microprocessor. The controller also contains a VME bus requester, thus allowing it to contribute Camac data, completely formatted, to a global event buffer.

20698 **A VME-VMX interface to Fastbus via the LeCroy 1821 Segment Manager.** Scheetz, R.A.; Le Vine, M.J. (Physics Dept., Brookhaven National Lab., Upton, NY 11973). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* NS-34: No. 4, 1036-1038(Aug 1987). (CONF-870552—). Contract AC02-76CH00016.

From 5. conference on real-time computer applications in nuclear, particle, and plasma physics; San Francisco, CA, USA (12 May 1987).

An interface between multiple LeCroy Segment Managers and a VME-VMX system is described. The host I/O registers of the 1821, and control registers for DMA have been mapped into the short I/O address space of VME. Transfers from the data memory of the 1821 occur via pipelined DMA to the VMXbus. As many as sixteen Segment Managers may be controlled by a single interface.

20699 **Dirichlet averages of x/sup t/ log x.** Carlson, B.C. (Ames Lab. and Dept. of Mathematics, Iowa State Univ., Ames, IA 50011). *SIAM Journal of Mathematical Analysis;* 18: No. 2, 550-565(Mar 1987). Contract W-7405-ENG-82.

A neglected class of special functions may be described as Dirichlet averages of chi/sup t/ log chi or equivalently as derivatives of hypergeometric R-functions with respect to the degree of homogeneity. Special cases include the derivative of a Legendre function with respect to the degree and the derivative of Gauss's hypergeometric function with respect to a numerator parameter. There are connections with the logarithmic derivative of the gamma function, with Euler's dilogarithm, and with /sub 3/F/sub 2/; some special cases of /sub 3/F/sub 2/ are thereby evaluated. Applications include a two-point boundary-value problem, mean values, series expansions of elliptic integrals, integral tables, and several physics problems. The discussion of various properties emphasizes series expansions, quadratic transformations, inequalities, and evaluation of special cases, including certain cases of the derivative of a Legendre function with respect to the degree.

20700 **The scalar Riemann problem in two spatial dimensions: Piecewise smoothness of solutions and its breakdown.** Lindquist, W.B. (Courant Institute of Mathematical Sciences, New York Univ., New York, NY 10012). *SIAM Journal of Mathematical Analysis;* 17: No. 5, 1178-1197(Sep 1986).

Consider the scalar quasilinear equation ∂μ(t,x)/∂t+„t„/sup n//sub i=1/ ∂f/sub i/(μ(t,x))/∂x/sub i/=0, for n=1,2,f/sub i/∈C/sup 2/: R→R. For n=2, we define the two-dimensional Riemann problem and show the unique (in the sense of Kruzkov) solutions are piecewise smooth for f/sub 1/ identical to f/sub 2/ identical to f, f purely convex or having a single inflection point. A mechanism leading to a presumed loss of piecewise smoothness is presented for f having three or more inflection points. The analysis is based on a study of the generalization of the one-dimensional Riemann problem to allow for initial data having a finite number or jump discontinuities with constant data or rarefaction waves between jumps.

20701 **(ANL/MCS-TM—103) A tool for the analysis of quasi-Newton methods with application to unconstrained minimization.** Byrd, R.H.; Nocedal, J. (Argonne National Lab., IL (USA)). Dec 1987. Contract W-31109-ENG-38;FG02-87ER25047. 15p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005783/JAW.

We show that the BFGS update formula has an important property that is independent of the algorithmic context of the update, and that is relevant to both constrained and unconstrained optimization. We also study the convergence properties of the BFGS method for unconstrained optimization, using a variety of line searches, including backtracking, and prove global and superlinear convergence on uniformly convex problems. The analysis is particularly simple due to the use of some new tools that we introduce in this paper. 14 refs.

20702 **(ANL/MCS-TM—104) Algorithms with conic termination for nonlinear optimization.** Liu, D.C.; Nocedal, J. (Argonne National Lab., IL (USA)). Dec 1987. Contract W-31109-ENG-38. 22p. NTIS, PC A03/MFA 01; GPO Dep. Order Number DE88005893/JAW.

This paper describes algorithms for unconstrained optimization which have the property of minimizing conic objective functions in a finite number of steps, when line searches are exact. This work extends the algorithms of Davidon and Gourgeon and Nocedal to general nonlinear objective functions, paying much attention to the practical behavior of the new methods. Three types of algorithms are described; they are extensions of the conjugate gradient method, the BFGS method and a limited memory BFGS method. The numerical results show that new methods are very effective in solving practical problems. 19 refs., 4 tabs.

20703 **(CMI-R—862352-1) Minkowski, Farkas and Weyl revisited; applications to finding extreme points, extreme rays and facets of convex polyhedra.** Nets, R.J.-B. (Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)). Oct 1986. 11p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751111/JAW.

We give new proofs of these theorems (for systems of linear inequalities) that rely on elementary algebraic identities. The proofs are constructive and naturally lead to implementable procedures for finding the extremal elements of convex polyhedra. 2 refs.

20704 **(CMI-R—872090-1) Matching problem with side constraints is NP-complete.** Aboudi, R. (Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)). Mar 1987. 13p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751183/JAW.

We define the constrained matching problem as follows: Given a graph, we identify subsets of the edges and require that each set is entirely contained in the matching or is disjoint from the matching. We show that the constrained matching is NP-complete. 1 ref., 2 figs.

20705 (CMI-R—872090-4) Resource constrained assignment problems. Aboudi, R.; Joernsten, K. (Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)). Jun 1987. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751201/JAW.

In many applications it is necessary to find a minimum weight assignment that satisfies one or several additional resource constraints. For example, consider the problem of assigning persons to jobs where each assignment utilizes at least two scarce resources, and the resource utilization is dependent on the person and the type of task. A practical situation where the above might occur is a slaughter house where the "cutters" are assigned to different cut patterns. In this case the resources are the time, the cost and the productivity measured in terms of quality and amount of the end products. In this paper the resource constrained assignment problem is studied, and several classes of valid inequalities based on the properties of the knapsack and assignment polytypes are derived. An algorithm is presented that uses both the linear programming and the Langrangean relaxation of the original problem in order to solve the separation problem. Some computational experiments are also given. 10 refs.

20706 (CMI-R—872330-1) Timing of resource development projects under price uncertainty and taxation. Haaberg, T.; Manne, P.; Stensland, G. (Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway)). Jul 1987. 35p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88751195/JAW.

We give optimal stopping rules for resource development investments. Resource price development is considered as a discrete time, random walk process. We use dynamic programming and obtain well known results for the optimal stopping rule of the Brownian motion when the time step in our model moves to zero. 8 refs.

20707 (DOE/ER/25015—12) Computation and graphics in mathematical research: Progress report, June 1, 1987-December 31, 1987. Hoffman, D.A.; Spruck, J.; Meeks, W.H. III. (Massachusetts Univ., Amherst (USA)). Jan 1988. Contract FG02-86ER25015. 23p. NTIS, PC A03. Order Number DE88005796/JAW.

The principal investigators, D. Hoffman, W. Meeks and J. Spruck, conduct research in differential geometry, calculus of variations and applied mathematics. Increasingly, this research has taken on a computational component, while still addressing problems of current theoretical interest in these subjects. This computational side has two important aspects: implementation of algorithms to solve problems in partial differential equations (arising from physical problems) and scientific graphics. Some of the research that we have done and are currently doing is described in this report. Critical to this research is the ongoing use of advanced computing equipment and the development of new graphics algorithms and interfaces tailored to the solution of computational problems in science. We have been able to make some connections between surfaces of constant mean curvature and surface interfaces in block copolymers. 24 refs.

20708 (ORNL/TM—10655) Nonlinear differential equations. Dresner, L. (Oak Ridge National Lab., TN (USA)). Jan 1988. Contract AC05-84OR21400. 132p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88006047/JAW.

This report is the text of a graduate course on nonlinear differential equations given by the author at the University of Wisconsin-Madison during the summer of 1987. The topics covered are: direction fields of first-order differential equations; the Lie (group) theory of ordinary differential equations; similarity solutions of second-order partial differential equations; maximum principles and differential inequalities; monotone operators and iteration; complementary variational principles; and stability of numerical methods. The report should be of interest to graduate students, faculty, and practicing scientists and engineers. No prior knowledge is required beyond a good working knowledge of the calculus. The emphasis is on practical results. Most of the illustrative examples are taken from the fields of nonlinear diffusion, heat and mass transfer, applied superconductivity, and helium cryogenics.

20709 (SAND—88-0113C) Campaign graphs. Simmons, G.J. (Sandia National Labs., Albuquerque, NM (USA)). 1988. Contract AC04-76DP00789. 16p. (CONF-880238—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005336/JAW.

From 19. southeastern international conference on combinatorics graph theory and computing; Baton Rouge, LA, USA (15 Feb 1988).

We define a class of geometrical constructions in the plane in which each (unextended) line lies on (precisely) k points, and every point is an endpoint of (precisely) one line. We will refer to any construction satisfying these conditions as a campaign graph, or as a k-campaign graph if the value of k isn't clear from the context. A k-campaign graph, G, is said to be critical if no subgraph of G is also a k-campaign graph. 11 figs.

20710 (SOL—87-16) A continuous time average cost flexible manufacturing and operator scheduling model solved by deconvexificiation over time. Eaves, B.C.; Rothblum, U.G. (Stanford Univ., CA (USA). Systems Optimization Lab.). Aug 1987. Contract FG03-87ER25028. 14p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005691/JAW.

A continuous time flexible manufacturing and operator scheduling problem is introduced and solved. The principal concern is with scheduling operators over time to various activities of a manufacturing system with the purpose of optimizing some steady state criterion. In mathematical terms the problem is modeled as a deterministic, infinite horizon, continuous time discrete dynamic program. Our solution procedure is to convexify the problem to obtain a linear program and then, to deconvexify the solution of the linear program over time to arrive at an optimal solution which is periodic and piecewise-constant. Apparent loss in object value due to the deconvexifications is circumvented with buffer inventories. The procedure can be reduced to solving a sequence of linear programs and the complexity can be stated in these terms. 5 refs.

20711 (SOL—87-17) Elimination of quantifiers of linear variables and corresponding transfer principles. Eaves, B.C.; Rothblum, U.G. (Stanford Univ., CA (USA). Systems Optimization Lab.). Nov 1987. Contract FG03-87ER25028. 17p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005692/JAW.

Given a first order formula for ordered fields whose quantified variables are linear with respect to each other, we show how to eliminate the quantifiers and obtain a quantifier-free formula that is equivalent to the original one over all ordered fields. The result parallels Tarski's Theorem that concerns the elimination of quantifiers for first order formula for ordered fields applied to real closed fields. Like Tarski's Theorem, our results yield transfer principles for drawing conclusions in one ordered field that are established for another. Applications of this transfer principle are discussed. 9 refs.

20712 (UCRL—53838) Stochasticity in nonlinear Hamiltonian systems. White, R.C. (Lawrence Livermore National Lab., CA (USA)). 1 Oct 1987. Contract W-7405-ENG-48. 147p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE88005499/JAW.

In this dissertation, we will describe principles involved in the research of nonlinear Hamiltonian systems in a few dimensions and provide both standard and new examples of such dynamical systems that exhibit chaotic behaivor. Analytical theories are discussed, which are not new, but which are measured accurately with modern computers. So, with the tools of computers and perturbation methods, we can describe the geometry of the phase space. 75 refs., 27 figs.

20713 (WHC-SA—0058-FP) The use of least squares in undetermined problems. Schmittroth, F. (Westinghouse Hanford Co., Richland, WA (USA)). Oct 1987. Contract AC06-87RL10930. 12p. (CONF-8710252—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88004473/JAW.

From Westinghouse statistical symposium; Pittsburgh, PA, USA (19 Oct 1987).

A Bayesian approach is taken to apply least squares to data analysis problems that would otherwise require alternative methods. Usually, least squares methods are used in overdetermined problems where a few model parameters are fit to a larger body of measured data. Prior estimates for the parameters can convert a problem lacking sufficient data for a unique solution to one that is mathematically well-posed. The advantages of least squares are retained, e.g., the proper inclusion of experimental uncertainties and correlations. Other benefits are obtained. Diverse sources of data may be combined in a consistent way including direct experimental measurements and weaker subjective parameter estimates. An example taken from gas tag analysis illustrates the method. Tagged reactor components may be identified when they leak small amounts of isotopically unique tag gas. However interference by background contamination, air for example, can complicate the analysis. Prior knowledge consisting of a crude estimate of the amount of background gas yields a tractable problem. Another problem taken from groundwater analysis illustrates the diversity of problems that may be considered. 6 figs.

20714 **The limited aperture problem of inverse acoustic scattering: Dirichlet boundary conditions.** Ochs, R.L. Jr. (Dept. of Applied Mathematical Sciences, Ames Lab., U.S. Dept. of Energy, Iowa State Univ., Ames, IA 50011). *SIAM Journal on Applied Mathemadics;* **47**: No. 6, 1320-1341(Dec 1987).

Let D be a bounded, simply connected domain in the plane and let F(θ, κ, α—/sub 1/) be the far field pattern arising from the scattering of a time harmonic, acoustic plane wave μ/sub 1/(chi—) = exp (ikchi— chi . a—/sub 1/), where α—/sub 1/ is a unit vector and κ is the wave number and the time harmonic factor e/sup -iwt/ has been factored out. It is assumed, in addition, that the total field satisfies homogeneous Dirichlet boundary conditions on ∂D. In this paper, a method is presented for recovering ∂D given the far field patterns F(θ; κ, α—/sub 1/), l = 1,..., N, for all θ in some interval $[\alpha,\alpha + \delta]$ strictly contained in $[0,2\pi]$. The method used is a generalization of the orthogonal projection approach of Colton and Monk for solving the full aperture problem. In addition, the above method is numerically implemented. These computations show that one can recover by this method the shape of ∂D if the length of the interval $[\alpha, \alpha + \delta]$ is as small as 180°.

20715 **Deterministic coin tossing and accelerating cascades: Micro and macro techniques for designing parallel algorithms.** Cole, R.; Vishkin, U. (New York Univ.). pp 206-219 of Proceedings of the 18th annual ACM symposium on theory of computing. New York, NY; Association for Computing Machinery (1986). (CONF-8605224—).

From 18. ACM annual symposium on theory of computing; Berkeley, CA, USA (28 May 1986).

Several results concerning parallel algorithms are improved. A partial list of the new results includes: For ranking a linked list of length n, O(lognlog/sup */n) time using an optimal number of processors. For selecting the m-th smallest out of n elements O(lognlog/sup */n) time using an optimal number of processors. For graph connectivity O(lognlog/sup (2)/nlog/sup (3)/) time using (m + n)α(m,n)/lognlog/sup (2)/nlog/sup (3)/n) processors, and for finding minimum spanning forest in a graph O(lognlog(/sup 2/)nlog(/sup 3/)n) time using (m+n)/(lognlog(/sup 2/)n) processors, where n is the number of vertices and m is the number of edges. All the new algorithms are deterministic. These results provide an optimal deterministic parallel algorithm for list ranking that achieves poly-log time. Also, they provide an optimal algorithm for connectivity which runs in almost logarithmic time when m $\geqq$ nlog/sup */n. This optimal algorithm achieves logarithmic time when m=n/sup 1-ϵ/, where $0<\epsilon\leqq 1$. Our results are also strong enough to refute a known conjecture regarding a limit on the possible performance of any parallel algorithm for the list ranking problem. This paper introduces a new deterministic coin tossing technique that provides for a fast and efficient breaking of a symmetric situation in parallel. Previously, it was known how to break such symmetries only by means of randomization. Interestingly, the structure of all the algorithms in this paper follow a paradigm which we call accelerating cascades. Given several alternative parallel algorithms for the same problem, this paradigm constructs a new algorithm for the same problem out of these algorithms; the performance of the new algorithm compares favourably with that of any of its building blocks.

20716 **Introducing efficient parallelism into approximate string matching and a new serial algorithm.** Landau, G.M.; Vishkin, U. (Dept. of Computer Science, School of Mathematical Sciences, Tel Aviv Univ., Tel Aviv 69978). pp 220-230 of Proceedings of the 18th annual ACM symposium on theory of computing. New York, NY; Association for Computing Machinery (1986). (CONF-8605224—).

From 18. ACM annual symposium on theory of computing; Berkeley, CA, USA (28 May 1986).

Consider the string matching problem, where differences between characters of the pattern and characters of the text are allowed. Each difference is due to either a mismatch between a character of the text and a character of the pattern or a superfluous character in the text or a superfluous character in the pattern. Given a text of length n, a pattern of length m and an integer κ, we present parallel and serial algorithms for finding all occurrences of the pattern in the text with at most κ differences. The first part of the parallel algorithm consists of analysis of the pattern and takes O(log m) time using m/sup 2/ processors. The rest of the algorithm consists of handling the text.

9903 Information Handling

REFER ALSO TO CITATION(S) 17634, 17635, 17734, 18254, 18487, 18512, 18533, 19368, 19553, 19554, 20003, 20576

20717 **(AD-A—186273/9/XAB) Saguaro: a distributed operating system based on pools of servers. Annual report, 1 January 1984-31 December 1986.** Andrews, G.R. (Arizona Univ., Tucson (USA)). 3 Mar 1986. 5p. NTIS, PC A02/MF A01.

Prototypes of components of the Saguaro distributed operating system were implemented and the design of the entire system refined based on the experience. The philosophy behind Saguaro is to support the illusion of a single virtual machine while taking advantage of the concurrency and robustness that are possible in a network architecture. Within the system, these advantages are realized by the use of pools of server processes and decentralized allocation protocols. Potential concurrency and robustness are also made available to the user through low-cost mechanisms to control placement of executing commands and files, and to support semi-transparent file replication and access. Another unique aspect of Saguaro is its extensive use of type system to describe user data such as files and to specify the types of arguments to commands and procedures. This enables the system to assist in type checking and leads to a user interface in which command-specific templates are available to facilitate command invocation. A mechanism, channels, is also provided to enable users to construct applications containing general graphs of communication processes.

20718 **(CONF-8705147—4) Guidelines for exchanging computerized information.** Olson, R.J.; Boden, T.A.; Solomon, J.A.; Dale, V.H.; Christensen, S.W. (Oak Ridge National Lab., TN (USA)). 1987. Contract AC05-84OR21400. 6p. NTIS, PC A02. Order Number DE88004736/JAW.

From Piecing the puzzle together: a conference on integrating data for decisionmaking; Washington, DC, USA (27 May 1987).

The exchange of computerized information is becoming more routine; however, it is often a time-consuming and frustrating process. Based on our experience in developing several large data bases at Oak Ridge National Laboratory, we estimate that there may be problems with at least one-third of the data files that are received or sent. The average time required to process data transferred from extant sources (based on records for 56 transfers) increased 37% when problems were encountered compared with the average processing time required for data files without significant problems. The majority of problems were related to inadequate documentation (49%). Other problems included hardware or software incompatibilities, errors in the tape or disk, errors or inconsistencies in the data, and transmittal of the wrong data set. Based on this analysis, we have developed guidelines for exchanging computerized information, giving the types of information needed to ade-

quately document a file, define the transfer medium, and verify that information is correctly received. The guidelines are meant to be adapted to individual situations as appropriate. 8 refs., 5 figs., 2 tabs.

20719 **(DOE/MA—0317) Information Resources Management Review Plan with year 3 update: FY 1986-FY 1988.** (USDOE Assistant Secretary for Management and Administration, Washington, DC. Office of Organization and Management Systems). Nov 1987. 124p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE88004264/JAW.

The DOE is a multidimensional organization with diversified missions and programs relating to energy. From the production of nuclear warheads and special nuclear material; the enrichment of uranium for fuel for the country's nuclear reactors; the marketing of electricity through the Power Marketing Administrations and the moving of the nation's oil reserves in and out of the ground; to the conduct of research in its National Laboratories and Energy Technology Centers on such devices as accelerators (atom smashers), fusion energy machines, nuclear test facilities, gasifiers, and other combustion machines; the Department engages in a myriad of information activities utilizing, in many cases, state-of-the-art information technologies. Other functions, including policy development, regulation, energy information collection and dissemination, conservation promotion, international cooperation, facilities and materials management, environment and security management, also involve many information activities. It is the policy of DOE, that the resources expended for the development, manipulation, transmission, storage, use and disposal of information be utilized in the most effective and efficient manner consistent with applicable laws and regulations in carrying out the Department's mission and programs.

20720 (IA—1427, pp 229-230) **Preliminary study of an expert system for evaluation of scientific publications.** Bar-Noy, T.; Blau, M.; Friedman, M.; Kandel, A. (Israel Atomic Energy Commission, Tel Aviv; Florida State Univ., Tallahassee, USA). Aug 1987. NTIS (US Sales Only), PC A13/MF A01. Order Number DE88780048/JAW.

In Research laboratories annual report 1986.

20721 (INDC(CCP)—274/L, pp 5-11) **Neutron physics constants bank of the I.V. Kurchatov Institute of Atomic Energy.** Yudkevich, M.S. Jun 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700652/JAW.

Original report in Russian was distributed as INDC(CCP)-237/G.

In Translation of selected papers published in Nuclear Constants 5(59), 1984.

This paper describes the structure and contents of a neutron physics constants bank consisting of libraries, service programs and data preparation codes for reactor calculations. Use of the bank makes the constants fully accessible to users. 13 refs, 1 tab. Translated from Russian.

20722 (INDC(CCP)—274/L, pp 13-21) **New version of the unified constant system package.** Voloshchenko, A.M.; Germogenova, T.A.; Isaenko, T.G.; Lukhovitskaya, Eh.S.; Nikolaev, M.N.; Olejnik-Ovod, G.M.; Savos'kin, M.M.; Fejgel'son, N.B. Jun 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700652/JAW.

Original report in Russian was distributed as INDC(CCP)-237/G.

In Translation of selected papers published in Nuclear Constants 5(59), 1984.

A unified constant retrieval system called OKS has been developed for convenient access to the constant systems ARAMAKO-2F, ARAMAKO-G, DENSTY, TERMAC and others, in calculating radiation transport, value functions and various functionals. Since the system was first developed in 1980 both its language and its functional contents have been improved and added to. In this paper the input language and performance of the new version are described. 11 refs, 1 fig. Translated from Russian.

20723 (INDC(CCP)—274/L, pp 23-31) **Group Neutron Data Library (GNDL).** Voronkov, A.V.; Zhuravlev, V.I.; Natrusova, E.G. Jun 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700652/JAW.

Original report in Russian was distributed as INDC(CCP)-237/G.

In Translation of selected papers published in Nuclear Constants 5(59), 1984.

The paper describes the structure, organization and basic data representation formats of the GNDL, which was developed at the M.V. Keldysh Institute of Applied Mathematics of the USSR Academy of Sciences for the purpose of neutron data storage and retrieval. A simple method for linking up applications programs with the library is proposed. 6 refs. Translated from Russian.

20724 (INDC(CCP)—274/L, pp 33-38) **ARMAN'YAK code.** Velikanov, V.V.; Savos'kina, G.V. Jun 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700652/JAW.

Original report in Russian was distributed as INDC(CCP)-237/G.

In Translation of selected papers published in Nuclear Constants 5(59), 1984.

The ARMAN'YAK (acronym from the Russian for "automated calculation of few-group neutron-nuclear constants") code is intended for compiling, on a computer's magnetic carrier, a library of files of nuclear concentrations, neutron spectra and few-group constants for further use as a simplified few-group system supplying constants for limited purposes. It may also be used in the preparation of constants for individual few-group calculations. 5 refs. Translated from Russian.

20725 (INDC(CCP)—274/L, pp 39-49) **Library of neutron data for calculating group constants.** Koshcheev, V.N.; Nikolaev, M.N. Jun 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700652/JAW.

Original report in Russian was distributed as INDC(CCP)-237/G.

In Translation of selected papers published in Nuclear Constants 5(59), 1984.

This paper describes the first version of a computerized library evaluated neutron data files (FOND) which includes data on the 67 most important nuclear reactor and radiation shielding materials. The data are represented in the ENDF/B format. The sources of data were the results of evaluations of data from differential neutron physics experiments conducted both in the USSR and abroad. The first version of the FOND library is not intended for use in reactor and shielding design calculations, but rather to serve as the basis for developing a corrected version which will guarantee adequate description of the results of a representative set of macroscopic experiments, and for generating multigroup constant systems in methodological research. 18 refs. Translated from Russian.

20726 (INDC(CCP)—274/L, pp 51-58) **INDEhKS program and archive system.** Manturov, G.N. Jun 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700652/JAW.

Original report in Russian was distributed as INDC(CCP)-237/G.

In Translation of selected papers published in Nuclear Constants 5(59), 1984.

This paper describes a set of programs for the comparative analysis of calculated and experimental data from integral and macroscopic experiments and for evaluating the accuracy of nuclear reactor parameter calculations by analysing the sensitivity of calculated reactor parameter values to the nuclear physics constants used in the calculations and to the uncertainties in those constants. The paper also describes applications of this system to reactor and shielding problems. 11 refs, 2 figs. Translated from Russian.

20727 (INDC(CCP)—274/L, pp 59-65) **On the present status of the ARAMAKO system.** Nikolaev, M.N.; Savos'kin, M.M. Jun 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700652/JAW.

Original report in Russian was distributed as INDC(CCP)-237/G.

In Translation of selected papers published in Nuclear Constants 5(59), 1984.

This paper reviews the present status of the ARAMAKO multigroup constant calculation system for solving neutron and gamma quantum transport equations and for calculations of linear and bilinear functionals of their fields. 12 refs. Translated from Russian.

20728 (INDC(CCP)—274/L, pp 81-89) **Program for calculating group constants on the basis of libraries of evaluated neutron data.** Sinitsa, V.V. Jun 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700652/JAW.

Original report in Russian was distributed as INDC(CCP)-237/G.

In Translation of selected papers published in Nuclear Constants 5(59), 1984.

The GRUKON program is designed for processing libraries of evaluated neutron data into group and fine-group (having some 300 groups) microscopic constants. In structure it is a package of applications programs with three basic components: a monitor, a command language and a library of functional modules. The first operative version of the package was restricted to obtaining mid-group non-block cross-sections from evaluated neutron data libraries in the ENDF/B format. This was then used to process other libraries. In the next two versions, cross-section table conversion modules and self-shielding factor calculation modules, respectively, were added to the functions already in the package. Currently, a fourth version of the GRUKON applications program package, for calculation of sub-group parameters, is under preparation. 14 refs, 2 figs. Translated from Russian.

20729 (INDC(CCP)—274/L, pp 91-106) **Evaluation of the methodical error in 26-group approximation.** Dolgov, E.V.; Tsibulya, A.M. Jun 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700652/JAW.

Original report in Russian was distributed as INDC(CCP)-237/G.

In Translation of selected papers published in Nuclear Constants 5(59), 1984.

The accuracy of calculation of linear and bilinear functionals using a 26-group approximation is evaluated by comparing fine-group (288 groups) calculations with group (26 group) calculations. It is demonstrated that multigroup calculations of fast reactors call for the calculation of slowing-down cross-sections on the basis of an approximative evaluation of the within-group spectrum. At present levels of accuracy of nuclear data the methodical error of a 26-group approximation is acceptable. In order to further increase the accuracy of calculated predictions of the main physical characteristics of fast reactors to the level required, it will be necessary to make a transition to a fine-group system of constants. Multigroup calculations cannot provide accuracies of the central reactivity coefficients better than tenths of a per cent (up to 1%) of the reactivity coefficient of the basic fuel isotope. 5 refs, 3 figs, 9 tabs. Translated from Russian.

20730 (INDC(CCP)—274/L, pp 107-115) **On the development of a fine-group constant system.** Dolgov, E.V.; Savos'kin, M.M.; Tsibulya, A.M. Jun 1987. NTIS (US Sales Only), PC A06/MF A01. Order Number DE88700652/JAW.

Original report in Russian was distributed as INDC(CCP)-237/G.

In Translation of selected papers published in Nuclear Constants 5(59), 1984.

Errors in the multigroup approximation are the main methodical errors in the calculation of flux and importance spectra and functionals. To achieve the required accuracy in calculating the main characteristics of fast reactors a transition must be made from 26-group to fine-group approximation. A description is given of a fine-group system of constants along with a status report on its development. 11 refs, 1 fig, 1 tab. Translated from Russian.

20731 (INDC(NDS)—197/LNA) **Report of the Nuclear Data Section to the International Nuclear Data Committee, March 1986 to August 1987.** Lorenz, A. (ed.). (International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee). Sep 1987. 31p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88700653/JAW.

This progress report of the IAEA Nuclear Data Section covers the 18-months period March 1986 to August 1987. It describes past, current and planned activities of the Section and presents the status of its nuclear data centre services and technology transfer. 1 fig, 1 tab.

20732 (K/CSD/TM—75) **Interim Design Database (IDDB) CADAM [Computer-Aided Design and Manufacturing] drawing retrieval program: User's manual for the IBM 3083U.** Gudmundson, C.W.; Schwarz, R.L. (ed.). (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Dec 1987. Contract AC05-84OT21400. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005486/JAW.

This manual is a guide to the Interim Design Data Base (IDDB) CADAM drawing information retrieval program on the Martin Marietta Energy Systems, Inc., IBM 3083 unclassified computer. An overview of the system is presented, this includes a description of the help and error messages available to the user. Section 3.0 of the manual describes how to access the IDDB system and how to operate the program functions using Database 2 (DB2). Time Sharing Option (TSO), and Interactive System Productivity Facility (ISPF) features employed by this system.

20733 (LA-UR—87-3909) **Planning an MIS [manufacturing information system] for a job shop environment.** Cover, L.E. (Los Alamos National Lab., NM (USA)). 1987. Contract W-7405-ENG-36. 17p. (CONF-871240—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88003161/JAW.

From Society of Manufacturing Engineers (SME) meeting; Dearborn, MI, USA (1 Dec 1987).

Several years ago the decision was made to computerize the information needed for management of the Mechanical and Electronics Support Division of Los Alamos National Laboratory and to centralize the resulting manufacturing information system (MIS) in one computer located at the main facility. The effort was contracted out to a software development company in July of 1981. After over five years, and in spite of tremendous investments of time and money in the existing system, the decision was made to phase out the existing system, start over, and try again to develop an information system that would meet the needs of the division. In January 1987, a study was initiated to formulate a long-range plan, which would effectively guide and direct MEC Division's information system development. Recent significant additions to the organization, changes in management staffing, and concerns for the adequacy and appropriateness of the hardware and software of the division's current MIS, led to the decision to perform the study. The study consisted of identifying the current and long-term information needs, consistent with the division's mission and goals, and recommending a plan to effectively implement information systems to fulfill these needs. Business Systems Planning (BSP), a methodology developed by IBM, was used in the study. 2 refs., 3 figs.

20734 (SAND—87-1992) **NBS/Sandia/ICDD electron diffraction database.** Carr, M.J.; Chambers, W.F.; Melgaard, D.K.; Himes, V.L.; Stalick, J.K.; Mighell, A.D. (Sandia National Labs., Albuquerque, NM (USA); J and M Systems Ltd., Albuquerque, NM (USA); National Bureau of Standards, Washington, DC (USA)). Dec 1987. Contract AC04-76DP00789. 16p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE88004635/JAW.

A new database containing crystallographic and chemical information designed specially for application to electron diffraction search/match and related problems has been developed. The new database was derived from two well-established x-ray diffraction databases, the JCPDS Powder Diffraction File and NBS CRYSTAL DATA, and incorporates two years of experience with an earlier version. It contains 71,142 entries, with space group and unit

cell data for 59,612 of those. The availability of unit cell data not only makes the database potentially useful for automated diffraction pattern analysis, but it also facilitates the calculation of allowed reflections with d-spacings greater than 0.82A for the ~59,000 entries having unit cell data. These calculated d-spacings are used in the database in preference to experimental x-ray data when both are available, since experimental x-ray data sometimes omits high d-spacing data which falls at low diffraction angles. Other searchable data in this new database include space group, reduced cell edge length, and reduced cell volume. Compound and/or mineral names, formulas, and journal references are included in the output, as well as pointers to corresponding entries in NBS CRYSTAL DATA and the Power Diffraction File where more complete information may be obtained. Atom positions are not given. Rudimentary search software has been written to implement a chemistry and r-spacing bit map search. With typical data, a full search through ~71,000 compounds takes 10 to 20 seconds on a PDP 11/23-RL02 system. 9 ref.

20735 **(SAND—87-2037-Rev.) DOE data exchange format specification, mechanical products/drafting: Version 1.3, CADCAM-045.** (Sandia National Labs., Albuquerque, NM (USA)). Jan 1988. Contract AC04-76DP00789. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005495/JAW.

The Data Exchange Format (DEF) has been developed as part of a Department of Energy (DOE) effort to integrate the Computer-Aided Design/Computer-Aided Manufacturing (CAD/CAM) activities throughout the Nuclear Weapons Complex (NWC). A primary objective of this effort is to provide a capability for the exchange of digital data between dissimilar CAD/CAM systems within the NWC. This specification is the result of a collective effort of the DOE Data Exchange Format Group charged with the task of defining a subset of the Initial Graphics Exchange Specification (IGES) to be used as the data exchange format for the mechanical products/drafting application.

9904 Law

20736 **(IAEA-TECDOC—422) Legislations the field of food irradiation. A survey conducted by the International Consultative Group on Food Irradiation established under the aegis of FAO, IAEA, WHO.** (Food and Agriculture Organization of the United Nations, Rome (Italy); International Atomic Energy Agency, Vienna (Austria); World Health Organization, Geneva (Switzerland)). May 1987. 75p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE88700615/JAW.

An outline is given of the national legislation in 39 countries in the field of food irradiation. Where available the following information is given for each country: form of legislation, object of legislation including information on the irradiation treatment, the import and export trade of irradiated food, the package labelling and the authorization and control of the irradiation procedures.

20737 (INIS-BR—910, pp 29) **Clinical NMR research - The economic opportunities of privatization.** McNabb, D.A.; Olson, D.O.; Porter, B.A.; McElroy, G.M.; Moss, A.A. 1986. NTIS (US Sales Only), PC A07/MF A01. Order Number DE88701073/JAW. (CONF-8606372—).

From 9. meeting of the International Society of Magnetic Resonance; Rio de Janeiro, RJ, Brazil (29 Jun 1986).

20738 **(INIS-XN—91) Decree No 86-80 of 13 January 1986 on artificial radioisotopes and amending the Public Health Code, in particular Articles R. 5234 to R. 5238.** (International Atomic Energy Agency, Vienna (Austria)). 14 Jan 1986. 3p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701326/JAW.

Published in Journal officiel - Lois et decrets No 15.

This Decree amends and supplements a Decree of 3 May 1954 concerning the use etc of artificial radioisotopes. The amendments relate to licensing conditions. (NEA).

20739 **(INIS-XN—93) Decree No. 87-137 of 2 March 1987 concerning the High Council for nuclear safety and information.** (International Atomic Energy Agency, Vienna (Austria)). 3 Mar 1987. 2p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701328/JAW.

Published in Journal Officiel de la Republique francaise.

This Decree amends the Decree of 13th March 1973 setting up a High Council for Nuclear Safety. Its purpose is to widen the terms of reference of the High Council for Nuclear Safety. In addition to its responsibilities as regards the safety of nuclear installations, it is now competent in the field of information. The Council is now charged with informing the media as well as the public not only on questions of safety proper but also on incidents and accidents occurring in nuclear installations. (NEA).

20740 **(INIS-XN—95) Atomic Energy Amendment Act 1987 - No. 5 of 1987.** (International Atomic Energy Agency, Vienna (Austria)). 13 Mar 1987. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701330/JAW.

This Act modifies substantially the Atomic Energy Act 1953 as already amended. It repeals almost all of the existing Atomic Energy Act, including the provisions establishing the Australian Atomic Energy Commission and the security provisions. A new authority is created under separate legislation to replace the Commission: the Australian Nuclear Science and Technology Organization. The only parts of the Act which remain are the sections covering the authorization of the Ranger Project and the Commonwealth title to uranium in the Northern Territory; and the requirement for reporting of discoveries of prescribed substances (uranium, thorium, i.e. any substance which may be used for production of atomic energy) and information on their production. Certain definitions have also been kept. (NEA).

20741 **(INIS-XN—96) Australian Nuclear Science and Technology Organization Act 1987 - No. 3 of 1987.** (International Atomic Energy Agency, Vienna (Austria)). 13 Mar 1987. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701331/JAW.

The purpose of this Act (ANSTO Act) is to establish a successor to the Australian Atomic Energy Commission (AAEC) set up under the Atomic Energy Act 1953. The Act provides for a new Organization with functions which, according to Government policy, better reflect the directions in which Australia's principal research organization should tend in that area, namely realignment of AAEC activities away from work on the nuclear fuel cycle, towards greater emphasis on applications of radioisotopes and radiation in medicine, industry, agriculture, science, commerce, etc. ANSTO is prohibited from undertaking any R and D into the design and production of nuclear weapons or nuclear explosive devices. (NEA).

20742 **(INIS-XN—97) Australian Nuclear Science and Technology Organization (Transitional Provisions) Act 1987 - No. 4 of 1987.** (International Atomic Energy Agency, Vienna (Austria)). 13 Mar 1987. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701332/JAW.

This Act implements certain transitional provisions consequent to the enactment of the ANSTO Act 1987. The legislation provides for the continuation of the body corporate from its present form as the Australian Atomic Energy Commission to the new body corporate, the Australian Nuclear Science and Technology Organization. (NEA).

20743 **(INIS-XN—100) South Pacific Nuclear Free Zone Treaty Act 1986 - No. 140 of 1986.** (International Atomic Energy Agency, Vienna (Austria)). 9 Dec 1986. 29p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE88701334/JAW.

The purpose of this Act is to give effect to Australia's obligations as a Party to the South Pacific Nuclear Free Zone Treaty of 6 August 1985. The Act is supplemented by the provisions of the Environment Protection (Sea Dumping) Act 1981 as amended in 1986 as regards dumping of radioactive material into the sea. The

Act repeats the substantive provisions of the Treaty and lays down prohibitions in relation to nuclear explosive devices. (NEA).

20744 **(INIS-XN—106) Radiation Control Act 1977 - No. 66 of 1977.** (International Atomic Energy Agency, Vienna (Austria)). 21 Sep 1977. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE88701340/JAW.

This Act regulates the use of radioactive materials and radiation-emitting devices. It sets up a Radiation Advisory Council to advise the competent authorities on questions within the scope of the Act, also with a view to radiation protection. The Act also lays down a licensing system for such materials and devices. The Radioactive Substances Acts 1954 and 1966 are repealed. (NEA).

9905 Civilian Defense

20745 **(AD-A—185750/7/XAB) Feasibility of software built-in test for SDI (Strategic Defense Initiative) applications. Final report, 9 February-31 July 1987.** Healey, R.D. (Atlantis Research Group, Inc., Peabody, MA (USA)). 15 Aug 1987. 49p. (TR—103-1). NTIS, PC A03/MF A01.

Software Built-In Test (BIT) is a design technique for collecting information from operational software that will assist in identifying differences between the real Operating Environment and either the Design or Test Environments. The BIT senses and indicates where the software is operating in new or overload environmental conditions and may, therefore, be more likely to fail. (This anomalous situation may be the result of either hardware failure or software design error.) The technical challenge is to incorporate the large number of relatively simple BIT tests into the fault-tolerant and continuously operating environment likely to characterize a solution to the battle management portion of the SDI mission. The management challenge is to provide these technical assists in such a way that they can be implemented in operational software with a minimal increase in software development time; it is then reasonable to expect that BIT will not shift from a hard requirement to a nice-to-have feature as schedule pressures potentially impact development. This approach overcomes the management problem by providing a standard set of tools for use within the software development environment which will implement BIT with a minimum amount of programmer action.

20746 **(LA—11172-MS) Where directed energy stands in strategic defense.** Canavan, G.H.; Browne, J.C. (Los Alamos National Lab., NM (USA)). Jan 1988. Contract W-7405-ENG-36. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE88005092/JAW.

Directed energy concepts can play unique, significant roles in strategic defense. This report reviews the various stages in their prior development, assesses their current status, and indicates the key indicators of offensive system development that determine the time frame in which they will be needed. Directed energy concepts are significantly less sensitive to kinetic energy countermeasures, for which they could be ready.

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